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Protection of the Fauna and Flora of Africa

IF a review is made of the steps which have been taken in the past to safeguard the fauna and flora of any particular country, it will generally be found that whatever has been done, or at any rate originated, in this direction has been almost entirely due to private enterprise or through the efforts of such scientific field societies as happened to be interested in some restricted portion, or individual members, of such faunas and floras. These societies, besides being very numerous, were necessarily of a very heterogeneous character, varying in that respect with the particular field of biological research in which they were more especially interested. They were generally handicapped by lack of funds, lack of public or private interest and consequently lack of means or opportunity for carrying out, *on the necessary scale required*, protective measures adequate for the schemes which they had in view. Each society, moreover, worked in its own limited field, usually without co-operation with other societies.

Thus, although we would not for a moment belittle the pioneering work which has been done in the past, this lack of co-ordination has contributed to a large extent towards rendering that devoted work either ineffective or of far less effect than it might otherwise have been. There has, in a word, been a tremendous output of individual energy, devotion and interest, with an inadequate and often disappointing result.

Fortunately, there has been a tendency in recent years to consider the protection of faunas and floras on a large and comprehensive scale, to realize more and more the essential interdependence of species, and, where protection is needed, to set aside larger and larger areas of country for that purpose. It has been realized, too, that protection on a large and efficient scale connotes international co-operation, that where in the past the efforts of individuals or individual national societies led the way, Governments must now step in and take up the work.

A good example of united action on a large scale has lately been manifest in the International Conference for the Protection of the Fauna and Flora of Africa, held in the House of Lords in May of this year. It was the second conference of its kind to be held, the first having taken place in 1933 in the same building. Both may be regarded as having inaugurated a new policy in dealing with the protection of animal and plant life; for although many international conferences have assembled to consider biological and economic problems relating to the welfare of individual species, none, so far as we are aware, has ever before been set the task of considering from the point of view of its protection the fauna and flora of an entire continent.

The second conference, like the first, was held under the chairmanship of the Earl of Onslow and was opened on behalf of His Majesty's Government by the Marquess of Dufferin and Ava, Parliamentary Under-Secretary of State for the Colonies. It was attended by Government delegates of the Union of South Africa, Belgium, Great Britain and Northern Ireland, Egypt, France, Italy, Portugal and the Netherlands. The interests of the Anglo-Egyptian Sudan were represented by the United Kingdom and Egyptian delegations jointly. A report of the proceedings has already appeared in NATURE of June 4. The main object of the second conference was to report progress since the holding of the first conference of 1933; to exchange information; and to engage in

exploratory discussion preparatory to a further conference which it is hoped to hold in 1939. An outline of the various delegates' announcements will be found in the report to which reference is made above.

In addition to these announcements, however, a report of the Committee of Experts relating to the principal species suitable for inclusion in the Annex to the Convention was handed in, and although for obvious reasons we cannot here consider this report in detail, there are two questions of a general nature to which this Committee has directed special attention, questions which are not easy of solution, and to the discussion of which we propose to devote a good deal of the space available.

The first of these questions relates to the method to be adopted to secure protection for species which, owing to their scarcity, require protection over wide areas in Africa, but are so relatively plentiful in certain other areas as not to require protection. The second relates to species which in the greater part of Africa do not require special protection, but, owing to special factors, are exceptionally scarce in certain areas, where, therefore, such protection is called for.

It was felt by those drawing up the report of the Committee of Experts that species falling into either of these categories could not, and indeed should not, be treated in the same way as species which are extremely rare throughout the whole range of their distribution. There will be general agreement among biologists with the Committee's view that some suitable method should be thought out for securing protection on an international plane for species in those parts of Africa where they are extremely scarce although they may be so plentiful elsewhere in Africa as not to call for such protection.

It may be added that in this connexion, the Committee of Experts, very properly we think, directed attention to the danger which exists when the population of any given species, or group of species, is reduced to a low ebb; and that any unnecessary disturbance of the balance of Nature may have far-reaching consequences the ultimate effect of which it is impossible in any given case to foretell.

To return, however, to the first question, which concerns species requiring protection over wide areas in Africa but plentiful in certain territories. It was brought to the notice of the Committee that there are a number of species found over wide areas in Africa of which all but possibly one or two subspecies are so scarce as to justify being placed in one or other of the categories of the Annex to the Convention. This, however, in certain cases has not so far been done, owing to the relative abundance of some subspecies in certain other areas. In dealing with this and another very similar type of case, the Committee suggested: (1) that there might be included in the Annex itself a direct exception in respect of whatever might be the territory where special protection is not required; and (2) that the Government of the territories in which special protection is not required should follow the precedent set by the Union of South Africa in the case of the aard wolf and the mountain zebra, in respect of which reservations were made by that Government at the time of the ratification of the Convention.

Coming to the consideration of species which we may refer to as those of Category 2, namely, those which require protection in certain parts of Africa only, the Committee was struck by the fact that there are a number of species which over the greater part of Africa do not require protection on the international plane, owing to their relative abundance in the majority of the territories concerned. On the other hand, in one or more parts of Africa their population is so reduced that vigorous action is necessary. Examples are quoted in the Committee's report in respect of the Cape hartebeest, *Bubalis caama*, and the oribi, *Ourebia ourebi*, which, it is understood, the national provincial administration proposes to protect on a scale equivalent to that given to species in Class A of the Annex.

It is suggested that these problems, which are mainly concerned with the welfare of mammals, may well be given careful consideration until such time as they may be brought up for final decision at the next conference, which it is proposed to hold in 1939, for they are problems urgently calling for solution.

There were other problems of protection, more especially concerned with birds, which the Committee of Experts was called upon to consider. One of these was concerned with the recent discovery of species like the African peacock, *Afropavo congensis* Chapin, and the African broadbill, *Pseudocalyptomena graueri* Rothschild. Both species are of very great zoological interest; for prior to their discovery the presence of neither peacocks nor broadbills had been suspected in

Africa; both have very restricted distributions indeed, and we may take it for granted that no museum of importance will rest content until it has secured specimens. To satisfy such a demand, local 'agencies' will be established; and unless great care is taken there will be over-exploitation with the inevitable and usual result. It is to be feared that this commercialization has taken place in the case of the very interesting flightless rail of Inaccessible Island.

We are far from advocating any pernickety interference with the privileges of the *bona fide* scientific collector, but we think there should be real and rational control on the part of the Governments concerned in cases of this kind. If there were, we should not be faced with the possibility of the extinction of such a biological treasure as the diminutive flightless rail just referred to. Until it was discovered by scientific investigators living an almost underground life among the rocks of Inaccessible Island, the inhabitants of Tristan da Cunha had been indifferent to its existence. As soon, however, as it was realized that 'there was money in it', its exploitation went on uncontrolled; in a similar way, other relatively rare or unusual animals, such as the African peacock and the broadbill, to mention just two other examples, will quickly be brought to the verge of extinction, unless adequate measures for their preservation are quickly devised.

Nature and Uses of Rubber Latex

The Chemistry and Technology of Rubber Latex

The Chemistry and Technology of Rubber Latex. By Dr. C. Falconer Flint. Based on Georges Génin's "Chimie et technologie du latex de caoutchouc". Pp. xx + 715 + 40 plates. (London: Chapman and Hall, Ltd., 1938.) 42*s*. net.

THE fund of information concerning rubber latex has attained its present proportions by contributions from two widely separated sources. For many years, excellent work has been in progress in the rubber-producing countries of the East on the physiology and general properties of latex, chiefly with a view to its use as a source of first-grade dry rubber of uniform quality. More recently, latex has become available in quantity in the industrial countries of the world, and this has led to intense and detailed study, particularly in Great Britain and the United States, of the problems associated with its use as latex in industrial processes. It follows that few men of unquestioned scientific attainments have had working experience in both fields of investigation.

Dr. Falconer Flint is one of these few. After service in the East as a scientific officer on the staff of the Rubber Research Institute of Malaya, he is now working in Great Britain for Imperial Chemical Industries, Ltd., on problems associated with the applications of latex as such. It will be with keen anticipation, therefore, that the reader will take up this book. He will be hard to please who is disappointed. Although the author's original intention was to translate the treatise prepared in 1934 by Georges Génin, he has in reality so amplified and extended it as to constitute the volume under review practically a new work. He presents an orderly, thoughtful, and balanced analysis of the literature, including patent specifications.

Proceeding from a historical introduction, the author treats rubber latex first as to its sources, composition, properties, employment as a source of raw rubber (including special varieties such as rubber crumb and powder) preservation, concentration, and transport. A later chapter is concerned with the physical testing of latex. The large volume of literature to be digested compels a selective treatment in many places, and by the courtesy of the Research Association of British Rubber Manufacturers the reviewer has been able to compare Dr. Flint's selected references with those on file in the comprehensive records of the Association's Intelligence Division. From this it would appear that the policy adopted has been to quote freely the literature of a subject when that literature is scanty, but to discriminate as the literature accumulates. In this way the more familiar tracts of knowledge are adequately treated and space is found for less familiar matter. For example, attention is directed to the fact that copper is a normal constituent of natural latex as it exists in the tree; moreover, that this copper is associated with the rubber particles rather than with the serum. The significance of this as regards the ageing of vulcanized rubber will be appreciated by every rubber technologist, and suggests an investigation into the ageing properties of vulcanized rubber freed from these traces of copper.

Again, in the sharply defined subject of surface tension of latex, significant in regard to foaming, every important reference seems to have been noted. When a selection has been imperative, what to include and what to omit is a matter of judgment, and the selection seems, on the whole, to have been wisely done. In the chapter on the physical testing of rubber latex, however, insufficient notice seems to have been taken of recent American research, particularly that by Wohler stressing the need for humidity control in tensile testing. In this connexion, more use might have been made of the opportunity, afforded by the chapter bibliographies, of including references not discussed in the text, as, by so doing, the work of the reader desirous of following up his study would have been facilitated with no great increase to the cost of production of the book.

The latter portion of the book takes up the discussion of the industrial applications of latex—a wide subject indeed, with ramifications extending far beyond the confines of the rubber industry. This section includes reviews of latex compounding and vulcanization, manufacture of dipped goods from latex, electro-deposition of rubber from latex, latex and textiles, various other important applications of latex, and synthetic latices. Here selection has been more severe. Thus, in the sixteen pages devoted to the vulcanization of latex, one is disappointed not to find a mention of the interesting work of Spence and Ferry. The insulation of wire and cables by latex processes is dismissed in two and a half pages, occupied mainly with a discussion of a single paper. The developments introduced by the Simplex Wire and Cable Co. ('Latox' cord) are ignored, as are some half-dozen general articles and still more patent specifications. A book of 88 pages published in the United States last year was devoted entirely to the use of latex in chiropody, but this subject is not even mentioned in the volume under review.

It is, perhaps, ungenerous to mention such imperfections, since omissions of this kind are almost inevitable in a review of so complex a subject and one in which knowledge is advancing so rapidly. We therefore hasten to add that in our opinion it would not be easy, within the limits set, to improve upon Dr. Flint's text. Indeed, the detail he is able to include is sometimes surprising, and indicates first-hand familiarity with the subject. For example, the reviewer was seeking information concerning an obscure detail in the manufacture of latex paper and the desired facts were located immediately on referring to the appropriate section in "Flint". Moreover, he writes concisely, clearly, accurately, and in polished style, while his authority is such that his guidance may be followed with confidence.

Each chapter concludes with a numbered bibliography. There are also author and subject indexes. These features will cause irritation to the experienced indexer. Strange liberties are taken with proper names, both of persons and of companies. Small letters and capitals are used with little regard to system. Such details, though a blemish on the book, are not misleading, and definite errors are relatively few (the reviewer has noted three). But the author index does mislead. It is incomplete in respect of both names occurring in the book and of page references to names entered in the index. The subject index is too short to be comprehensive. The title of the book also is unfortunate, in that it lends itself to confusion with "Chemistry and Technology of Rubber" recently issued by the publishers of the present work, and with the journal *Rubber Chemistry and Technology*. Confusion of this kind has already occurred in two cases known to the reviewer.

The fact remains that Dr. Flint has written the most comprehensive treatise on his subject that has yet appeared, and all interested in either the scientific or industrial aspects of latex will be well advised to obtain and use this work. Printing and binding are good. T. H. MESSENGER.

Patent Medicines in Great Britain

Patent Medicines
By Prof. A. J. Clark. ("Fact", No. 14.) Pp. 98. (London: "Fact", 1938.) 6*d*

SOME of the facts revealed in this book will come as a surprise to many people. Patent medicines is a convenient misnomer for remedies the reputation and sale of which depends more upon advertisement than upon proved efficacy. The name of the remedy is protected as a trade mark, and vast sums are spent on making the name a household word. These advertisements enjoy remarkable legal privileges, including specific exemption from the Foods and Drugs Act. The publication of fictitious testimonials from bogus physicians is common practice and quite legal. The use of fictitious testimonials from real physicians is less common, but a physician who sued a firm for this offence lost his case.

The proprietors of secret remedies pay a tax

and must affix a stamp to each packet. This stamp looks like an official guarantee, but since it is only applied to remedies the composition of which is not only secret, but also potentially variable, it cannot possibly be anything of the kind. The tax can be evaded, and secrecy, to some extent, maintained by publishing the composition in a form which the public cannot understand, and considerable ingenuity is shown in the invention of words like 'hydroxyethane' and 'trihydroxypropane'. The actual composition is not considered important, and is often decided upon quite casually.

Patent medicines do harm by making the nation hypochondriacal, by delaying the rational treatment of cancer and other diseases until it is too late, by wasting the money of poor families when there is incurable disease in the house, and by poisoning. Prof. Clark omits the tale of the cure for obesity which consisted of living tapeworms, but quotes several authentic cases of widespread poisoning from secret remedies. There is no law against the distribution of medicines with unknown properties. New synthetic products sometimes have remarkable therapeutic properties, but they should be tested under careful observation before being sold indiscriminately.

Various legal reforms were advocated in the strongly worded report of the Select Committee on Patent Medicines which was unfortunately published on August 4, 1914. Prof. Clark supports the recommendations of this Committee, and believes that action has been delayed by the fact that the Press derives large revenues from the advertisers of patent medicines and is reluctant to lose this source of income. The law is particularly lax in Great Britain.

The book is probably an overstatement of the case, and is likely to irritate anyone who actively distrusts the medical profession; but it is much more readable than any dispassionate statement of the facts could have been. It is not intended as an attack on all the advertisements of medicines, since the author clearly realizes that important advances in therapeutics have been made in the laboratories of reputable firms, whose incomes depend largely upon advertisement, but whose ethical standard is high. J. H. G.

Trade Cycles

The Mechanics of Prosperity

By Hobart C. Dickinson. Pp. xvi+136. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1937.) 9*s*.

WHEN the admitted imperfections of the present monetary system come to be impartially and scientifically investigated, the system advocated by Mr. Dickinson in this book will surely deserve consideration. The book is directed to American conditions, and does not attempt to give a complete survey; in particular, it scarcely touches at all on the unstabilizing effects of gold—to which Prof. Gustav Cassel gave such prominence in his recent book, "The Downfall of the Gold Standard", confirming the views of the late Sir Basil Blackett, in his "Planned Money".

Mr. Dickinson, in contrast to the two authors just mentioned, takes the view that the trade cycle arises primarily from the operation of interest—which in his view is neither completely elastic in rate, and returned to circulation (as assumed in classical economics) nor reinvested and compounded at a fixed rate (as assumed by Marx). It follows that, owing to this 'stickiness' of interest rates, accumulations of unused spending power occur periodically, and cause a temporary inflation which is followed by deflation. During deflation the debts, due to the issue of new money and credits during the inflation period, are wiped out by bankruptcy and defaults, and the cycle begins again.

The author's remedy is that the State shall operate as a form of savings bank, accepting money on deposit at an attractive rate of interest when occasion demands, and utilizing the proceeds in the execution of desirable public works by private contract, so that the unused spending power is restored to circulation. The State may also 'retire' money. In this way the 'work-flow' is kept constant. When normal conditions return, the rate of interest on deposits is lowered. All deposits may be withdrawn at any time—the Government issuing new money (*not* bonds), without interest, for the purpose; or the Treasury may sell securities.

Inflation is prevented by the imposition of taxes on unearned profits (due to rise of price-level): for example, a national retail sales tax, and a capital gains tax, which are applied automatically, and at appropriate rates, on the rise of price-level of goods or securities, and discontinued when the price-level falls again. The author claims that this system of stabilization, which substitutes public works at home for enterprise abroad, avoids the necessity for securing a favourable trade balance, and thus makes for international peace.

The author does not discuss the alternative methods of encouraging spending and preventing the accumulation of unused purchasing power, such as the depreciating money advocated by Silvio Gesel in his book, "The New Economic Order", or the interesting proposals of Dahlberg, in "When Capital goes on Strike".

Some of the present author's conclusions—for example, his objections to taxation for the purpose of providing "social security", such as old age pension, etc.—are not in accordance with British experience, and his disregard of the effects of the varying value and supplies of gold (or silver) on price-levels and purchasing power is open to criticism. The scheme is clearly described, and constitutes a useful contribution to the growing literature of monetary reform.

R. A. S. P.

Elementary Science

(1) Chemistry (with some Geology)
By J. A. Lauwerys and J. Ellison. (New General Science Series.) Pp. xii + 356. (London: University of London Press, Ltd., 1938.) 4*s*. 6*d*.

(2) Introductory General Science
By Dr. L. M. Parsons. Pp. viii + 308. (London: Macmillan and Co., Ltd., 1938.) 3*s*. 6*d*.

(3) General Science
By Miss I. C. Joslin. Pp. viii + 360. (London: Macmillan and Co., Ltd., 1937.) 4*s*. 6*d*.

(4) Elementary General Science
By T. H. J. Field. Book 1. Pp. viii + 200. (London: Edward Arnold and Co., 1937.) 2*s*. 6*d*.

FOR the past twenty years or so, a movement has been afoot for a more liberal approach to science in the schools; and, although this movement has latterly shown signs of becoming widespread, there are still many masters and mistresses who hesitate to put their belief in it into practice. One serious drawback to the wider adoption of courses in general science has been the lack of text-books from which the ordinary work of the laboratory or the classroom might be supplemented or even directed.

(1) The chief interest of the first volume named above lies in the insight it affords into the kind of technique which may be employed in the teaching of general science. The title, "Chemistry (with some Geology)", indicates that this is no ordinary book according to standard pattern. It is one of a series for which two smaller volumes afford an introduction through the medium of topics. The companion volumes in the series proper are concerned with biology and physics. The authors have solved the difficulty of indicating important related matters in the biological and physical fields by a series of cross references, thereby avoiding unnecessary repetition, whilst emphasizing the inter-relationship.

In the selection of subject-matter the book is outstanding, for in this the break with tradition is most marked, and the authors are to be congratulated on a work which must be regarded as a pioneer achievement. A consideration of water and solutions introduces ideas of solubility and crystallization; and, following the next chapter on the composition of water, comes a simple treatment of fundamental geology. Here the new emphasis is clearly apparent: chalk, carbon dioxide, carbonates, lime, cement, hardness of water, furring, water softeners, sand, glass, coal, coal gas, coal tar, pass under review; and each arises for discussion perfectly naturally, though in an order which is unorthodox. Then the general process of winning metals from their ores provides a fresh approach to the further resources of the earth. Copper, iron and lead are examined with emphasis on their service to man, and a consideration of the protection of metallic surfaces by painting leads to the whole question of the chemical activity of the metals and the subject of equivalence. At this juncture, some chemical theory is necessary and the laws of constant composition and multiple proportions, and a simple treatment of atomic weights and valency are introduced.

After this pause for consolidation, the sea is considered as a source of raw materials: salt, hydrochloric acid, chlorine, bromine, iodine and fluorine being treated with a refreshing vitality. So to the air as a further source of raw materials and to the story of nitrates and ammonia. The consideration of sulphur and its uses in industry and a further section of chemical theory mark the end of such chemistry in the book as has normally been regarded as proper in a school certificate course.

Much that is found in such courses has been omitted, and the reason is not far to seek: the authors have regarded it as of less importance than those matters to which the remaining third of the book is devoted. It is indeed refreshing to

find attention being paid here to sugars and starch, cellulose and paper, rayon and celluloid, alcohol and wines, beer and vinegar, esters, fats and oils. Foods, fuels and explosives occupy a further sixty pages before the final chapters on electricity in the service of chemistry, and on light with reference to chemical action. One is left with the impression of a good story well told.

An important question remains to be answered: granting that it is all very interesting, is it not very superficial? Will a pupil be benefited by such a course as it is claimed that he is by one which is narrower but more intensive? A key to the answer to this can perhaps be found in the many questions which follow each chapter. These are a striking feature of a striking book. Those who can answer them will need a sound knowledge of the facts and principles of chemistry and a considerable facility in applying this knowledge to new situations. Stimulating in their originality, these questions represent a noteworthy attempt to produce a conscious transfer of training whereby the pupil will be made to realize that there is chemistry outside the test-tube and outside the laboratory.

While Messrs. Lauwerys' and Ellison's book is intended to be used in conjunction with other texts, the remaining three here reviewed cover the whole range of general science. They thus give a clearer indication of the scope which supporters of that subject—if it can be called a 'subject'—consider desirable. Clearly, there is a much wider measure of common agreement than is often supposed. All three books maintain some form of subject division, though sometimes chapters on different subjects follow each other. In all cases, physics, chemistry and biology are the staple ingredients of the diet. In all cases, too, the application of scientific knowledge to everyday activities is made clear and the social importance of science is stressed. Lastly, while generalities are by no means ignored, formal theoretical work plays a much smaller part than has hitherto been thought necessary.

(2) Dr. Parsons divides his work into three parts: physics, chemistry and biology. To some extent, his book is an abridged version of his well-known "Everyday Science". The biological sections, however, are almost entirely new and they contain an excellent chapter on the human body in health and disease. The material is up to date, and a great number of applications are described and explained. Some attention is paid to meteorology and to simple mineralogy—these are welcome features. The biological sections, as is now usual, are arranged functionally.

(3) Miss Joslin in her book starts with the earth and the solar system. Though the astronomical section is not extensive, it will be welcomed by children, who almost always find this subject fascinating and exciting. She goes on to consider simple mechanics, physics and chemistry. The last third of her book is devoted to biology, including a chapter on hygiene and the human body. An interesting aspect of Miss Joslin's book is the attention she pays to domestic appliances. Possibly this may prove to be the best avenue through which girls may profitably approach the principles and generalizations of science.

Both of the two foregoing books are attractively written and are obviously the work of experienced teachers. Miss Joslin has included nearly a hundred experiments to be performed by the pupils, and teachers will be helped by the clear directions which she gives. Nevertheless, two important difficulties remain: the material in both books is all of about the same order of difficulty, and the various subjects are rather separated. Teachers will have to use these books rather freely, but this is probably what the authors intended.

(4) Mr. Field's book covers the first year only of a general science course, clearly planned on concentric lines. His arrangement is interesting and many of his ideas are novel. He pays much attention to the soil and uses these studies in a very profitable manner. The most interesting part of his book is that in which he deals with biology—the animals of the soil, for example. Here he treats of garden slugs, wireworms, centipedes, tiger-moths, aphis, greenfly, and he adds an excellent chapter on the cultivation of the runner-bean. In fact, most of the biological work he suggests could be done in a suburban back-garden. This is a feature which will be found very useful by many teachers. Furthermore, Mr. Field has graded his work well, he gives considerable help to the teacher, and his style is simple and direct.

All these four books illustrate the great advance which has taken place in the production of text-books for schools during the last ten years: they are illustrated by numerous photographs; explanations of simple applications and of familiar things abound; the style of presentation is lively, vigorous and direct. Above all, science is made to appear attractive, and the interests and needs of the pupils receive full consideration. It is clear that teachers of science are beginning to find their inspiration in the everyday world rather than in the somewhat rarefied atmosphere of specialist courses. Further progress, however, is still desirable. Much more, for example, might be done to assist children to transfer scientific modes of thought to ordinary life and to relate the school work more closely to the social background.

The Birds of Kenya Colony and the Uganda Protectorate

By Sir Frederick John Jackson, K.C.M.G., C.B. Completed and Edited by W. L. Sclater. Vol. 1: Struthionidae to Psittacidae. Pp. lii+542+10 plates. Vol. 2: Coraciidae to Sylviidae. Pp. viii+545–1134. Vol. 3: Hirundinidae to Emberizidae. Pp. viii+1137–1592+6 plates. (London: Gurney and Jackson, 1938.) 90*s*. net.

TO the making of bird-books there is no end, and out of the vast bird-fauna of Africa there comes continually something new. For more than thirty years, Sir Frederick Jackson served his country in East Africa, ending as Governor of Uganda, and all his leisure was spent on safari, mostly in the happy study of the birds. He planned a great book, but left it unfinished. It has now been completed with the utmost care and skill by Mr. W. L. Sclater, and, beautifully illustrated by Mr. Lodge and Mr. Grünwald, it takes its place beside the works of Reichenow, Shelley, Sclater and Bannerman.

In a graceful preface, Lady Jackson tells how her husband on his first arrival in East Africa was cheered by the call of a curlew and gladdened by the familiar sight of sandpipers, oyster-catchers and ringed plovers. It is indeed wonderful to find true swallows, kestrels, nightjars and many another homely bird, not to speak of the all but world-wide osprey and barn-owl, all at home in the same land with trogons, barbets, plantain-eaters, guinea-fowl and the endless host of foreign fowl besides. The book is packed full of field notes, straight from the diary of a true field-naturalist. An admirable example is Sir Frederick's account of the great fish eagle (*C. vocifer*), the home of which is on Lake Victoria, and which ranges from the ocean to the Belgian Congo. How its mode of fishing differs from the osprey's is beautifully explained; and the zoologist will be interested to know how it catches perch, catfish and an occasional lungfish (or *Protopterus*), but leaves the last uneaten! The hammerhead (*Scopus*), the ground hornbill and several of the sunbirds are a few more among the countless examples of Sir Frederick's powers of observation and description. The book is a fine memorial to a modest and a useful life.

Outline of Historical Geology

By Dr. A. K. Wells. Pp. xiv+266. (London: George Allen and Unwin, Ltd., 1938.) 12*s*. 6*d*. net.

DR. WELLS'S new book, although essentially a text-book of stratigraphy, is something more than a formal descriptive catalogue of the various divisions and subdivisions of the geological column. It is an excellent general account of British stratigraphy, pleasantly written in the form of a continuous narrative, and very fully illustrated by line drawings, many of which have been specially prepared.

The book is expressly intended for beginners in geology, either undergraduates about to commence a course in this subject, or general readers who wish to acquire a knowledge of geology for cultural reasons. The author's experience as a lecturer is sufficient guarantee that the text is suitable for the first class of reader, but it is rather doubtful whether the needs of general readers with absolutely no previous knowledge of the subject are adequately met.

Such readers would surely be curious about the various geological processes that have operated in past ages to produce the rocks that now form the earth's crust. This branch of historical geology is, however, rather summarily dismissed in the short introductory chapter (further references to geological processes are, it is true, made in the text, *en passant*). A more complete account of these processes seems desirable in order that uninformed readers may fully appreciate the details of stratigraphy, with which 'historical geology' is largely concerned. Again, although technical terms have been avoided wherever possible, a general reader would probably appreciate a glossary in explanation of some that are used.

Apart from beginners, specialists in other branches of geology will find this work provides an excellent refresher course in stratigraphy, and it should be appreciated by a wide circle of readers.

Comprehensive Index of the Publications of the American Association of Petroleum Geologists, 1917–1936

By Daisy Winifred Heath. Pp. vi+382. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1937.) 13*s*. 6*d*. net.

THE comprehensive index to the first twenty volumes of the *Bulletin of the American Association of Petroleum Geologists* is a fitting tribute to the work achieved by the Association during the first two decades of its existence. In 1917, the production of petroleum in the United States amounted to approximately 355 million barrels, whereas in 1936 it exceeded one billion barrels. The first volume of the *Bulletin*, issued in 1917, contained 176 pages, whereas the twentieth volume contains 1868 pages. This in itself is proof of the efforts made by the Association to further the search for oil and aid its scientific development during these years. The value of the work has been immeasurably enhanced by the compilation of an index, which facilitates reference to all publications of the Association during the period 1917–36.

Numerical Problems in Advanced Physical Chemistry

By J. H. Wolfenden. Pp. xx+227. (Oxford: Clarendon Press, 1938.) 7*s*. 6*d*. net.

MOST teachers of advanced physical chemistry will have felt a need of a collection of examples taken from modern publications on such subjects as photochemistry, dipole moments, activity coefficients, kinetics and molecular spectra. Mr. Wolfenden's book contains an adequate number of such exercises with answers and explanatory notes, although for the theory the reader is referred to text-books. The book is attractively produced and its price is very moderate. It may be recommended as likely to prove very helpful both to teachers and to students.

Les Instruments de Musique de Madagascar

Par Prof. Curt Sachs. (Université de Paris : Travaux et Mémoires de l'Institut d'Ethnologie, 28.) Pp. ix+96+15 plates. (Paris : Institut d'Ethnologie, 1938.) 37.50 francs.

THIS study of the musical instruments of Madagascar by Prof. Sachs, the well-known authority, fills a gap in the study of primitive music, which in itself is not a little remarkable. As the author points out, ethnographical museums and collections of musical instruments are singularly ill-supplied with specimens from this source. The Musée du Trocadero, however, or the Musée de l'Homme, as it is now called, possesses a collection of nearly two hundred examples. Prof. Sachs, accordingly, has prepared a *catalogue raisonné* of the collection, and in order to make his study as complete as possible, has supplemented it with a description of types to be found in other collections, or if not otherwise available, recorded in the literature.

In view of the ethnic composition of the people of Madagascar, in part African, in part of Malayan origin, and keeping in mind its geographical position, which has made it from early times accessible to all the seafaring peoples who traversed the Indian Ocean, it is not surprising to find that the musical instruments are of a varied character and mixed origin—African, Malayan, Indonesian, Arab and European. Nor is it safe to infer that when an instrument has been traced to its place of origin, it has reached Madagascar direct. It may have come, for example, by way of India. Hence it will be seen that the task which Prof. Sachs has set himself of constructing a chronology is by no means simple. One very interesting point which emerges is connexion with the instruments from Malaya. The absence of the Javanese gong and other bell-like Indonesian types leads to the conclusion that the Malayan instruments cannot have been introduced in the island later than the beginning of the Christian era.

Elementary Mathematics for Electrical Engineers

By Sir Ambrose Fleming. Pp. 110. (London : George Newnes, Ltd., 1938.) 5*s*. net.

THIS handbook of mathematics is designed to provide the engineering student with just those practical parts of the subject which are of the greatest importance to him. The subject-matter, arranged in ten sections, ranges from simple to differential equations ; from the elements of trigonometry to hyperbolic functions and from plane co-ordinate geometry to vector algebra and harmonic analysis. There is a commendable continuity in the treatment of such a variety of topics, the connecting link being naturally the calculus, which is the foundation of engineering calculations.

The section on quadratic equations may prove somewhat confusing as an x is missing in several places on p. 16, and in the following paragraph, the condition for *one* real root is explained after the existence of *two* roots has been well illustrated.

There are few exercises for the student, but many of the basic principles are well applied to some interesting and really practical problems. Some useful tables are given at the end by the use of which numerical calculations may be facilitated. The engineering student should find this a very useful book, in spite of its brevity, and, if he makes himself thoroughly acquainted with its contents, he will be able, as the author hopes, to continue his mathematical studies from more advanced works on mathematics.

The League from Year to Year (1937)

Pp. 246. (Geneva : Information Section, League of Nations ; London : George Allen and Unwin, Ltd., 1938.) 1*s*.

UNDER the title "The League from Year to Year (1937)" the Information Section of the League of Nations Secretariat has issued its annual survey of the League's activities in 1937. This volume of 246 pages gives a clear and concise review of all the main activities of the year in sufficient detail to emphasize the value and significance of the technical co-operation which is being maintained in spite of the deterioration in the international political situation.

Scientific workers should find in the volume much material to facilitate the study of technical questions in which they are specially interested. The chapter on communications and transit, for example, refers to action taken in relation to oil pollution at sea and in regard to road transport. A separate chapter is devoted to nutrition, while the chapters on the Health Organization and on intellectual co-operation indicate very clearly the significant contribution to human welfare that is being made in those fields.

Other chapters deal with mandates, the Permanent Court of International Justice, economic and financial work, the protection of minorities, opium, social questions, etc. ; a detailed chronological table of the chief events of the year so far as the League is concerned is also included.

Commonwealth Bureau of Census and Statistics, Canberra

Official Year Book of the Commonwealth of Australia. No. 30, 1937. Prepared by Dr. Roland Wilson. Pp. xxxii+1021. (Canberra : Government Printer, 1938.) 5*s*.

THE Commonwealth Year Book is always most informative. It contrives, mainly through the medium of statistics, to give a view of Australian life as a whole. It would be difficult to find any important aspect of Australian activity that is omitted from its pages, and where considerations of space demand curtailment of treatment, full reference is given to relevant publications. In many aspects also the statistics are all the more useful since comparable statistics are given for other States.

The book contains a number of maps, including an average annual rainfall map, an air route map, a railway map and a map of artesian basins. The number of artesian and subartesian bores increases only slowly, but on the other hand the area irrigated by surface water has grown in several States. As usual, a long list of books on Australia appears.

Ice

By the late Dr. A. E. H. Tutton, F.R.S.

THE subject of Sir William Bragg's Friday evening discourse at the Royal Institution on March 18 last is one which is of deep interest from a remarkable variety of points of view, among them that of the crystallographer, the physicist, the geologist, the climber, the ski-runner, the plumber, the food purveyor and distributor, and even the very housewife herself. Moreover, it is one which has proved of unusual difficulty, although it concerns natural phenomena of the most familiar kind and one of the most abundant substances in Nature. Indeed, we never seem to get a thorough and complete understanding concerning the extraordinary nature and unusual properties of ice, although they have been investigated and discussed for ages. Only quite recently, an Association for the Study of Snow and Ice has been formed in Great Britain, now numbering about eighty members, the nucleus being the British members of the International Commission of Ice and Snow, which deals with the survey of glaciers and the prevention of catastrophes due to them. One of the latest discussions at the London meeting of the Association concerned "The Structure of Flow of Glacier Ice".

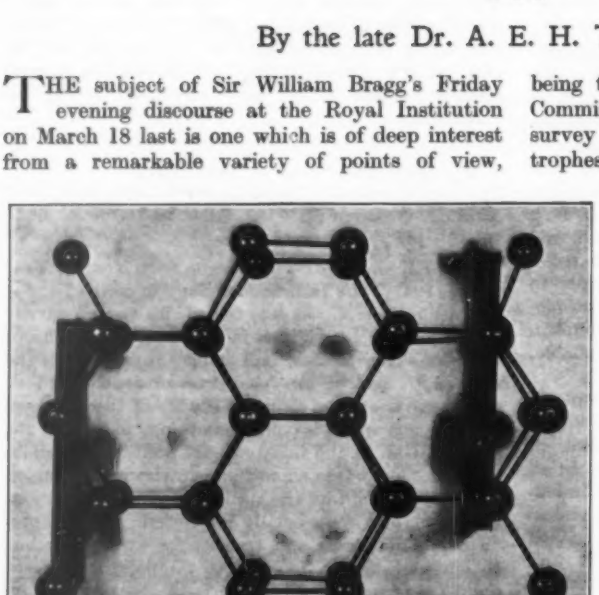


Fig. 1.

One property of ice, its crystal form and structure, and especially the system of symmetry to which it belongs, has, however, now after long discussion been settled, a satisfactory conclusion mainly derived from the X-ray analysis of ice crystals, which we owe largely to Sir William Bragg himself. For ice is now definitely known to crystallize in the hexagonal system, and in the holohedral class exhibiting the full symmetry of that system, the dihexagonal bipyramidal. A whimsical, yet very beautiful, illustration of this fact is afforded by one of the exquisite photographs of snow-flakes taken in a severe winter on the other side of the Atlantic by Mr. Wilson Bentley, one of the four thousand which we owe to his genius, no two of which are alike while all exhibit the same symmetry. For this particular snow-flake, of the plate-like rather than the feathery star-like kind, resembles almost ridiculously closely a grandfather-clock face in its case, with twelve markings very like Roman numerals, in exactly the positions of the twelve hours. These twelve markings correspond to the dihexagonal character of the crystal; for if the symmetry had been merely trigonal, as so long supposed, one would have expected the markings to have been only six, corresponding to ditrigonal symmetry.

The crystallographic facts now definitely known regarding ice crystals, due to the work of Dennison, Sir William Bragg and Prof. Barnes, may very briefly be stated. The space-group is D_6^4, corresponding to the class already mentioned. There are four molecules of water in the unit cell of the structure, the dimensions of which are $a = 4{\cdot}53$ A., $c = 7{\cdot}41$ A. The ratio of the axes is $c : a = 1{\cdot}634$. This structure remains unchanged for all temperatures between 0° C. and − 183° C. The density of the crystals is 0·9168, and their cubical expansion coefficient is 0·00016.

Sir William now regards the ice crystal as a set of parallel sheets of puckered hexagons, as shown in the photograph of a model reproduced in the upper part of Fig. 1, the observer being supposed to be looking along the optic (hexagonal) axis, perpendicularly to the basal plane. The sheets are connected by links perpendicular to them. The balls in the photograph (and model) are supposed to be oxygen atoms; for as hydrogen has so little effect on X-rays owing to its extreme lightness, the position of the hydrogen atoms is even yet not quite certain, although there is great probability that they lie between the oxygen atoms alternately with them, in such a manner as causes the hydrogen atoms to be double in number to the oxygens. The second photograph in the lower half of Fig. 1 was taken at right angles to the upper one, showing two sheets, the observer looking along the basal plane. Each oxygen atom lies at the centre of a tetrahedron, of which the four corners are occupied by other oxygen atoms. The distance between adjacent oxygen atoms is 2·74 angstrom units, whether in the same sheet or two neighbouring sheets.

Sir William directs attention to some singular experiments in 1936 by McFarlan, as to the effect of pressure on the structure, from which it would appear that under high pressures ice changes its structure somewhat, forming in succession two different forms, II and III, and two other photographs were shown in the lecture, reproduced in Fig. 2, of form II. While the sheets remain much the same, they are brought nearer together by the pressure, as shown in the lower half of Fig. 2. In form III the sheets also give way.

Tamman in 1910 first observed this remarkable fact, and showed that the forms II and III are solids at the low temperature of liquid air, by actually removing them from the steel high-pressure cylinder after releasing the pressure. The new solids rapidly changed into ice, with a large increase of volume, at the ordinary atmospheric pressure. Bridgman in 1912 confirmed Tamman's facts, using pressures up to ten thousand kilograms per square centimetre. McFarlan has taken the matter further by obtaining X-ray analyses of these two forms II and III, at the low temperature of − 155° C., and concludes that they are polymers of ice, having eight molecules of water to a side-centred orthorhombic cell in the case of II and sixteen molecules to a body-centred orthorhombic cell in the case of III. McFarlan appears to have found pressures up to 2100 atmospheres adequate for the production of these two new forms of solid water. He gives the space-group of II as V^8—$C\,222_1$, and the cell dimensions $a = 7{\cdot}80$ A., $b = 4{\cdot}50$ A., and $c = 5{\cdot}56$ A.; and for III the space-group V^{26}_h—$Ibam$, and the dimensions $a = 10{\cdot}20$ A., $b = 5{\cdot}87$ A., and $c = 7{\cdot}17$ A.

The slip or glide-plane of ice, made known in

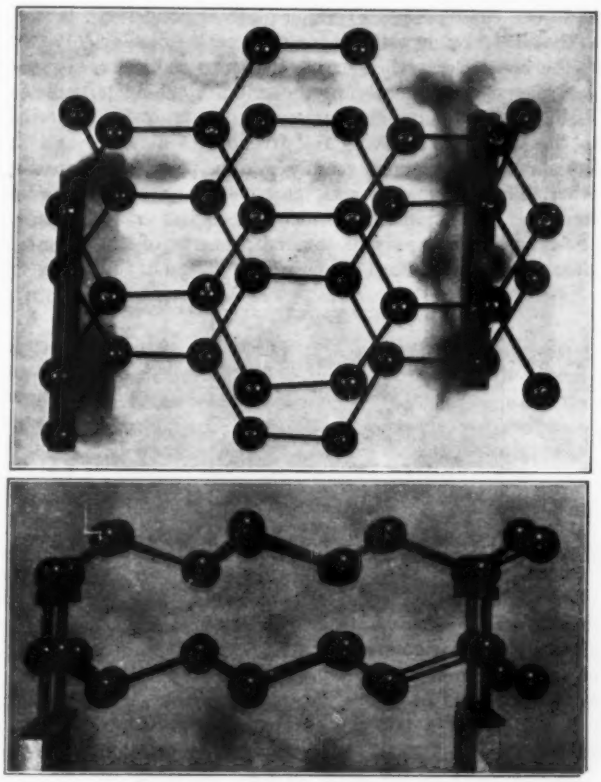


Fig. 2.

1891 by the work of McConnell of Cambridge, a frequent visitor to Davos for health reasons, and fully confirmed by all recent work to be parallel to the basal plane, is due to the readiness with which the sheets of hexagons, although puckered, can glide over one another. Moreover, water freezing in an open pond or vessel crystallizes as a plate parallel to the basal plane. Hence McConnell, in order to test the plasticity of single ice crystals, cut some bars of ice from single crystals from a frozen lake surface, the bars being several inches long and an inch or so wide and deep. Each was supported in turn near its two ends, and a weight was suspended by a loop from its middle. When the bar had been cut with its

length parallel to the basal plane and the water surface, and was arranged on the supports with its upper surface also horizontal, parallel to that same plane, a little bending occurred when the weight was placed in position; but it was only elastic bending, and the original position was restored on removal of the weight. If the bar were turned over on its other side, with the basal plane now vertical, practically no bending at all occurred on adding the weight. But if the bar had been cut from a very thick plate of pond ice, so that its length could be made to be perpendicular to the basal plane, then on adding the weight the bar sagged continuously in the middle, taking a V-shape with a more and more acute angle, owing to the glide plane having full freedom of action, the sheets of hexagons readily gliding past each other. The deformation was, moreover, permanent to almost the complete extent. Indeed it seemed at first as if this newly discovered property of the glide plane might afford a better explanation of the

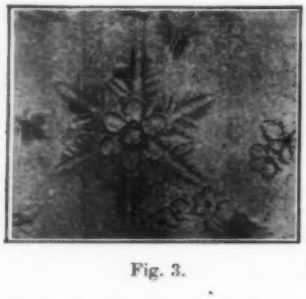


Fig. 3.

movement of glaciers than regelation. For a glacier is a conglomerate of single crystal grains, closely fitting together, with irregular bounding surfaces instead of crystal facets.

Even this was not the only additional factor required to supplement the inadequate regelation principle of Faraday (the freezing together of freely floating pieces of ice on contact) and Thomson and Tyndall (the liquefaction under pressure and re-freezing on removal of the pressure). For the crystal grains are usually promiscuously orientated, neutralizing each other's glide-plane movements. But subsequent researches showed that the irregular bounding surfaces are in reality liquid films, the pressure occurring from time to time during the glacier's movement down its unevenly inclined bed being most effective at these boundaries. Hence, molecular transpiration across them occurs, the crystal grains growing in size as the glacier descends, so materially indeed that while it is microscopic in the upper reaches, the 'firn', it may be as great as a yard or more at the snout of the glacier.

Of course Sir William emphasized the fact that the liquefaction of ice by pressure is rendered possible by the very open structure of ice, as revealed by X-rays, which also accounts for the abnormal expansion (instead of contraction) of water on freezing. I would like to add that it is even yet rarely appreciated how immense is this volume change which occurs on the freezing of water, compared with the thermal expansion of either ice or water. That of ice has already been mentioned (0·00016), and that of water is not far different; between 7° and 8° C. it is 0·000053, between 10° and 11° it is 0·000091, and between 19° and 20° it is 0·00021, the average coefficient between 10° and 20° and also the actual coefficient at 15° being exactly 0·00016. For the interesting interval between the maximum density at 4° (or more accurately 3·945° C.) and 0° (without freezing) the total expansion of the water is only one ten-thousandth of its bulk. But when freezing occurs there is a sudden expansive leap of nearly one-tenth of the whole volume of water frozen. The 'water-flowers' (Tyndall's 'ice flowers') or negative ice-crystals, produced in a slab of lake-ice by passing through it the hot rays from an electric lantern, are particularly interesting as illustrating the foregoing fact most elegantly, for they always exhibit a vacuole about their centre, of about one-ninth of the water content in the whole star-like cavity. Sir William exhibited a film which had been taken at the Royal Institution of this phenomenon, and Fig. 3 reproduces one of the best of these six-rayed 'flowers' shown by the film.

At the recent meeting of the Snow and Ice Association already mentioned, Dr. C. H. Desch emphasized the necessity of distinguishing between plastic and viscous flow. He pointed out that the former means an immediate yield under constant stress, and quoted Ruskin's example of butter (plastic) and honey (viscous), as an excellent illustration of the difference. He also showed that no formula can be found for the flow of glacier ice because flow is here complicated by recrystallization. He also propounded the question as to whether, in the production of a crack in ice leading to the formation of a crevasse, the fracture occurred between the crystals or along the basal planes (glide planes) within the crystals. In this connexion, I well remember being present at the startling event of the birth of a crevasse. It occurred during a crossing of the Alphubeljoch from Saas-Fee to Zermatt, in company with Alessandro Corsi of Macugnaga. Suddenly there was an explosion like a rifle shot fired at one's feet, at which both of us leapt forwards (the rope being taut between us). On recovering our equanimity and looking down at the glacier surface, which at that spot had been unusually free from crevasses, we perceived a thin sinuous line of crack extending as far as we could see on

each side of us, which obviously, before our eyes, opened more and more, until as we left to resume our climb this new crevasse had widened to more than a couple of inches.

The chairman of the Association, Mr. Gerald Seligman, quoted recent work indicating that the individual crystal was the unit of glacier movement, and that the slightest differential movement of the crystal grains might well be one of the principal causes of glacier movement. It is to be hoped, and indeed expected, that confirmation or otherwise of this view, and the answer to Dr. Desch's question, may be forthcoming from the investigations now proceeding at the Jungfraujoch by Mr. Seligman and his collaborators.

In conclusion, it appears to me that practically every seriously suggested cause for the movement of glaciers that has ever been put forward does operate, each playing its part when the conditions are favourable to its operation, and several of them usually acting simultaneously. This opinion is not merely the result of an attempt to digest all the voluminous records of practical scientific work on glaciers, but of personal study commenced so long ago as the year 1891, materially assisted by careful examination of nearly two thousand photographs of ice and snow formations on glaciers and mountains, taken by me personally during more than thirty seasons spent in the Alps, besides visits to the Rocky Mountains and the Himalayas.

Cambridge Meeting of the British Association

General Arrangements

THE Sectional programmes for the Cambridge meeting of the British Association were outlined in NATURE of July 16; it remains to add some general remarks to the notice which appeared in these columns when the preliminary programme was issued last April.

The attendance promises to be large: it should well exceed the average figure (which, since, but excluding, the centenary meeting in 1931, is 2,274); and this despite the unusually early, and to some members rather disconcerting, date of the meeting, August 17–24. This was inevitable, in order to meet the convenience of the colleges which are so generously offering their accommodation to visitors. Those who remember the last Cambridge meeting, in 1904, may recall that it fell on exactly the same dates, for the same reason. Nevertheless, the attendance then was 2,789, a very high figure for those days, but one which the present officers (and especially the General Treasurer) would very gladly see surpassed this year. It may well be, however, that the indulgence of late-comers will have to be sought if there be not room for them all to hear Lord Rayleigh's presidential address on August 17. The same drawback supervened in 1904, when many were unavoidably excluded from the Corn Exchange in which Mr. Arthur (afterwards Lord) Balfour as president inaugurated the meeting. On the present occasion the address will be given in the Regal Cinema. There is more room there than in the Corn Exchange (and certainly those present will listen in conditions of greater comfort); but there may not be enough for all members. It has therefore been decided to number and reserve all seats and to issue tickets early next month to members according to priority of their intimation to be present; any who receive tickets but who do not intend to use them will be besought to return them at once in order that they may be made available for other members. Consideration is being given to the desirability of relaying the address to another hall, a facility not available to the harassed officers in 1904.

The general arrangements are nearing completion, and an ample list of excursions and visits has already been issued to those who have intimated intention to attend. The full programme and timetable, together with the specially compiled scientific survey of the Cambridge district, will be sent out as usual some ten days in advance of the meeting.

In recent years, the Association has attempted to meet a widespread demand for more specific attention to the direct relations between science and its bearing upon the life of the community, by the simple method of indicating in the programme all communications which bear specifically on this question. There will, however, be presented to the Council and the General Committee important proposals to place the study and presentation of this aspect of the advancement of science in a more clearly defined position within the Association. It will be recommended that a Division for the social and international relations of science be established—the Council having already approved this step in principle, and has appointed a committee to consider and report upon the method of working the new Division. The inclusion of international relations is made with the more confidence because the interest of the American

Association for the Advancement of Science in these questions is well known, and a representative delegation from that body is expected at Cambridge to confer with the officers of the British Association upon the ways and means of closer co-operation. The report of the committee will be circulated early in August to all members of the General Committee known to intend to be present at the meeting. The same committee of the Council was charged with a review of the methods of publication at present practised by the Association, the principal medium being the annual report, which many people have long regarded as a graveyard of scientific communications the relegation of which thereto not infrequently appears to be something less than they deserve. A far-reaching proposal will be put forward in this connexion.

It will be apparent from previous announcements that the scientific programme will be full of worthy subjects, and one not previously mentioned calls for notice here. The visit of the scientific delegation to India last winter was so notable an episode that it has been felt to call for due recognition at Cambridge, and it is hoped to hold a special meeting, with Sir James Jeans, the jubilee president of the Indian Science Congress Association, in the chair, at which some of the delegates will give their impressions of the tour. Also an exhibition of photographs taken by delegates will be displayed in the reception room; the party was fortunate in including a number of very skilful amateur photographers. Another unaccustomed exhibition will be that of paintings and drawings by members of the Association, some of whom are already well known as artists in their hours of relaxation, though hitherto there has been too little opportunity to appreciate their work.

In certain directions, therefore, the Cambridge meeting may be expected to add materially to the history of the Association. In one other, it will assuredly do so. For the first time, a sherry party finds place in the official programme. It will be given in Emmanuel College by the Mayor and Mayoress of Cambridge—a very welcome innovation.

Among other social functions will be a reception by the University in the Senate House and Old Schools on Thursday evening, August 18. There will be informal conversaziones in Trinity College on Friday evening, August 19, and in St. John's College on Monday evening, August 22. Garden parties will be held in Downing College and Sidney Sussex College on Friday afternoon, August 19, and in Christ's College and Queens' College on Monday afternoon, August 22.

Full details of the social functions will be published in the programme and time-table.

The Piltdown Man Discovery

Unveiling of a Monolith Memorial

ON July 23, Sir Arthur Keith unveiled a monolith memorial which has been placed in the grounds of Barkham Manor, Piltdown, Sussex, to mark the spot where the late Mr. Charles Dawson found the fossil skull of Piltdown Man (*Eoanthropus dawsoni*). He paid a tribute to Mr. Dawson, whose important work as an amateur deserved our gratitude and remembrance. He remarked that the Piltdown skull is so different from any other human skull previously discovered, that the divergent opinions expressed by those who have attempted to interpret it are not surprising. In 1912–1913, when the fossil was found, much less was known of early man than is known at present. If a similarly novel discovery were made now, there would be closer agreement among those who studied it. Sir Arthur is more impressed at present with the simian characters of the skull and brain-cast, as well as those of the lower jaw, than he was when he originally examined the fossil.

After the unveiling, Sir Arthur Smith Woodward gave some reminiscences of his collaboration with Mr. Dawson at Piltdown, and he added that the first subscription towards the memorial was received from the late Prof. Henry Fairfield Osborn, of New York. Brigadier-General E. G. Godfrey-Faussett, chairman of Council of the Sussex Archæological Society, spoke of the generosity of landowners to archæologists, and expressed thanks to Mr. D. Kerr of Barkham Manor. The memorial was designed by Mr. Percival Bridgman of Lewes, and is made of durable Carboniferous sandstone from Yorkshire.

The following is the substance of Sir Arthur Keith's speech:

Mr. Charles Dawson—solicitor and antiquarian—has been in his grave these twenty-two years; he

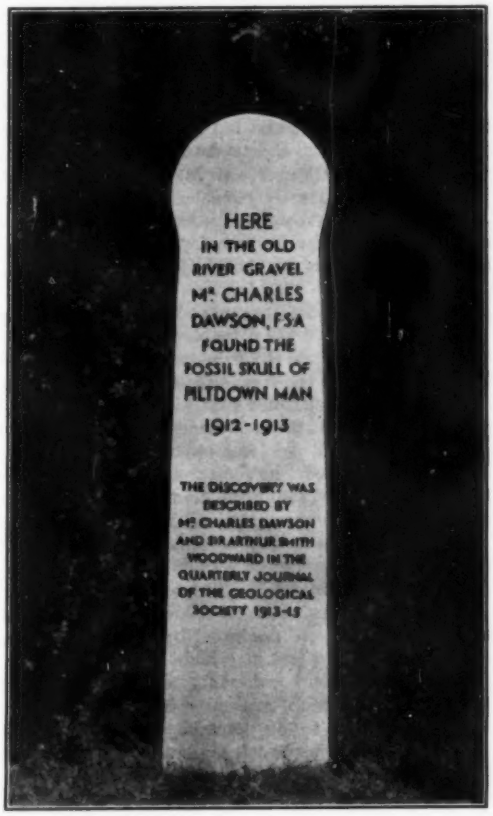
died in 1916 at the age of fifty-two, but the discovery he made on the spot where we are now assembled, the fossil remains of the earliest Englishman known to us, goes on growing in magnitude and in importance. The fossil bones he gathered here from a heap of road metal by the wayside—the private way leading to Barkham Manor—gave us the entrance to a long-past world of humanity, such a world as had never been dreamt of by anyone in England or in any other land.

I have in my hand a guide book to Sussex published in 1911. It was written by my learned friend—the late Mr. A. R. Hope Moncrieff. He assured his readers that the earliest inhabitants of Sussex were the 'celtic tribes', whose camps can still be traced on the Downs. When these words were being written by Mr. Moncrieff, Mr. Dawson was assembling evidence that carried the history of man in Sussex back to a remote period—one to which geologists assign a duration of half a million of years—or perhaps twice that amount. This discovery was not sent to Mr. Dawson by the fickle goddess, chance; it came to him because knowledge knew how to use its opportunities. The Weald was then alive with antiquaries, searching for the handiwork of ancient man. Mr. Dawson had his own beat, and searching for implements in that beat, he met with the fossil remains of a maker of the older stone implements.

The greater the novelty of a discovery, the more it departs from ascertained knowledge, the greater is the difficulty of getting it into its right perspective and the longer is the time needed to reach that end. More than ninety years ago an exciseman named Boucher de Perthes found worked stone implements in ancient deposits in the Somme Valley; it took seventy years to prove that what was true of the ancient deposits of the Somme Valley is repeated in every great river valley of the Old World. In 1857, when Neanderthal man was discovered, diverse explanations were given to account for the brutality of his structure; it took half a century of exploration to place him in his proper place in history. He proved to be a representative of the Europeans of a remote period, the period which saw the onset of the last glaciation of Europe.

The fossil remains found at Piltdown by Mr. Dawson set students of man's evolution the most difficult task that has confronted them hitherto. In his characterization, Piltdown man was quite unlike any fossil type known to us. Sir Arthur Smith Woodward was impressed by his simian similarities; I, on the other hand, was impressed by those features which, as I thought then, were eminently human and modern. Hence arose those discrepancies between us—discrepancies of a quarter of a century ago.

Since then, much has happened. Discoveries are being made which help to throw Piltdown man into his proper place in the crowded throng of evolving human forms. We now know that when the Piltdown type was being evolved in England—or at the western end of the Old World—a totally different type had come into being in the Eastern lands of the Old World. The Eastern types had low receding foreheads, modelled as in the gorilla and chimpanzee. The Western or Piltdown type differed; it had a relatively upright and high forehead, modelled not on gorilla lines but rather on those of the orang. While the Eastern forms retained in their shape of head the low squat type of the chimpanzee and gorilla, the Western or Piltdown type tended to assume the higher vaulted skull seen in modern races. There is no denying that in many of his features Piltdown man foreshadowed some of the structural modifications we find in modern races of mankind. Sir Arthur Smith Woodward, I know, will agree with me as to how Piltdown man came by such



Reeves, photo, Lewes.

features: he came by them independently, for discoveries of recent years have proved that diverse races of mankind have undergone the same structural change quite independently of each other. And there is also no denying that through all his known parts there runs a simian vein in Piltdown man, in his skull and brain as well as in his mandible.

So long as man is interested in his long past history, in the vicissitudes which our early forerunners passed through, and the varying fate which overtook them, the name of Charles Dawson is certain of remembrance. We do well to link his name to this picturesque corner of Sussex—the scene of his discovery. I have now the honour of unveiling this monolith dedicated to his memory.

Obituary Notices

Mr. C. F. M. Swynnerton, C.M.G.

THE recent death of Charles Francis Massy Swynnerton, as a result of an aeroplane accident in Tanganyika Territory on June 8, has been a heavy loss to science and especially to all who are interested in the development of tropical Africa; and it is particularly deplorable in that it occurred at a time when he had just been placed in a position to apply on a much larger scale the scientific ecological methods that he had devised for the control of tsetse-flies.

Swynnerton was born on December 3, 1877, in Lowestoft, going to India later, where his father was senior chaplin to the Indian Army, his mother being the daughter of Major W. H. Massy, of Grantstown Hall, Tipperary. He was educated at Lancing College and went out from there to Southern Rhodesia at the age of nineteen years, where for many years he was engaged in farming in the Melsetter District, then generally known as Gazaland.

Being a very keen all-round naturalist, Swynnerton soon turned his attention to the birds of that area, and during 1907 and 1908 he published a series of papers (250 pp.) in the *Ibis* recording his observations. Owing largely to the fact that his farm comprised a portion of Chirinda Forest, a most interesting patch of residual tropical rain forest which was then quite unknown botanically, he soon took an interest in the plants of the district and sent home a large collection to the British Museum (Natural History). This was eventually worked out by various specialists, and an account of it was published in the *Journal of the Linnean Society* in 1911. The collection contained nearly 1,100 species, of which 190 were new to science; several of these were described by Swynnerton himself, including two fine new mahogany trees.

Swynnerton then became interested in the problem of the significance of form and colour in Nature, and as he possessed to an unusual degree a capacity for precise and impartial observation, without any trace of that unfortunate urge to bolster up one's own theories or to smash those of other people, I suggested to him that he should undertake a really large-scale experiment to test unpalatability in insects and the deductions based on it in the theory of mimicry. He then began a long series of experiments lasting over five years in which very large numbers of insects of all kinds were used, the butterflies alone totalling more than 17,000. These experiments were made not only with captive animals, but also with wild birds, and were the first scientifically precise investigations in this field, and served to show the unreliability of much of the earlier work and also of criticisms based only on a few casual observations, or on the examination of the contents of birds' stomachs. The mass of evidence obtained was so great that less than half of it has been published (principally in *J. Linn. Soc.*, Zool., **33**, 203–385; 1919), though he rejected his first five hundred experiments for fear that they had not been done critically enough. He demonstrated that his birds when really hungry would eat almost anything, becoming increasingly discriminative as the stomach filled, so that a graded series of preferences could be compiled with considerable accuracy.

In 1918 a breakdown in health necessitated Swynnerton getting away from the worries of farming, but with his characteristic untiring energy he considered that a change of work was the best type of holiday. At my suggestion he turned his critical mind to a study of the tsetse problem, for which his intimate knowledge of the fauna, flora and geology of the country specially fitted him. With the assistance of the Mozambique Government he spent three months in analysing the tsetse situation in the Mossurise District of Portuguese East Africa. His comprehensive report (*Bull. Ent. Research*, 2, 315; 1921) contained a number of original ideas, and threw an entirely new light on the ecological aspects of the complex tsetse problem. It was here that he first recommended the use of controlled grass-fires as an economical method for eliminating these flies, a suggestion the value of which has been amply demonstrated in parts of Tanganyika and southern Uganda, where the vegetation was suitable for it. In 1919, he became the first game warden of Tanganyika, with instructions to study the relations between game and tsetses, and in 1921 he made a preliminary survey which showed that two-thirds of the Territory was infested by these flies. An outbreak of human trypanosomiasis, carried by *Glossina swynnertoni*, in Mwanza district started him on the practical work of controlling the fly, and he inspired and organized the first voluntary communal effort on a large scale by the natives themselves to stop the advance of the fly by well-planned clearing of bush. The successful results led to a great increase in this work, and a timely visit to the country by the then Under-Secretary of State for the Colonies, the Hon. W. Ormsby Gore (now Lord Harlech), led to official recognition of the importance of his work, so that funds were made available for its extension. Nevertheless, incessant and unjustifiable difficulties were placed in his way by critics of his methods, which nearly disheartened him, but thanks to his unflagging persistence a special Department of Tsetse Research was established in 1929, and Swynnerton left the Game Department to become its first director.

Here Swynnerton soon collected around him a small band of first-rate scientific workers and field officers, whom he trained and inspired by his own untiring energy and enthusiasm. These men have carried on a precise and intensive investigation of the ecology and habits of *Glossina* in all their complex aspects, and the work accomplished has been summarized by Swynnerton in his outstanding publication "The Tsetse Flies of East Africa", which will long be the standard work on the subject.

The results obtained are such that it can now be said with some assurance that the recovery of large areas of valuable land from the tsetse-fly has become economically feasible under the control of specially trained men; and it is to be hoped that the Department that Swynnerton built up will be allowed to continue its separate existence and carry on the great work for Africa which he initiated.

GUY A. K. MARSHALL.

Mr. B. D. Burtt

THE tragic loss, through an aeroplane disaster, of Mr. C. F. M. Swynnerton, Director of the Tsetse Research Department, and of Mr. B. D. Burtt, botanist to the Department, robs East Africa, at one blow, both of a distinguished zoologist and administrator and of a field worker who had a more intimate knowledge of the vegetation of Tanganyika, and probably of East Tropical Africa as a whole, than any other living botanist. The loss is the greater since news had just been received that the work of the Department was to be extended.

Bernard Burtt was the son of Dr. A. H. Burtt of York, who was himself a botanist. Young Burtt, who was born in 1902, was educated at the Friends' School, Ackworth, and at University College, Aberystwyth, and came to Kew in 1923. He did not shine in examinations, but as an all-round naturalist he was outstanding. Although he held a temporary post in the Kew Herbarium, his real interest was in the open—the living collections, the local insect fauna, and the bird-life in Richmond Park. Later he assisted his cousin, Dr. J. Burtt Davy, who was preparing the first volume of his "Flora of the Transvaal". Burtt's opportunity came when the tsetse fly campaign was organized. The writer well remembers Swynnerton visiting the Herbarium in search of a botanist for field work in Tanganyika. Burtt's services were pressed with every confidence. He went out to East Africa in 1925 as District Reclamation Officer, an appointment in the Tsetse Reclamation branch of the Game Preservation Department. When that branch later became the independent Department of Tsetse Research, he became the survey botanist for that Department. He threw himself with all his enthusiasm into the work, the interrelationships of the fly, the game and the vegetation, and it is doubtful which of the three held the greatest attraction, for one possessed, as he was, of such intense biological interests and sporting instincts. Though not the official ecologist to the Survey he became an ecologist in the widest sense. At the same time he always appreciated and fostered taxonomic studies, both botanical and entomological.

Burtt was an excellent collector. His herbarium material was usually sufficient for a five-fold distribution; a set each for Kew, the British Museum and the Imperial Forestry Institute, Oxford, a fourth and fifth set being retained in Africa for Amani and for his own Department. The collections as a whole were dealt with at Kew, though specialists at South Kensington and Oxford helped in the identification of their respective groups. Burtt's energies taxed the Kew staff to its utmost, one of his last sendings consisting of thirty-one cases. His material was always good, and often represented little-known or new species. But though he collected many novelties, they were not his first interest. He was concerned with the vegetation as a whole, the component species and the fly, though he was quick to spot a "beautiful new species", as he fondly termed them. He did not care for writing, and published little. When on leave, mountain exploration always had a strong appeal; he collected on Hanang and the Ngoro-Ngoro crater and surrounding mountains, besides the better known summits, and he was probably the only British botanist to climb and collect on the difficult ground of the old crater of Mount Meru.

Latterly Burtt travelled much by air, surveying the vegetation and the haunts of various species of tsetse-fly. In order to see more of Central Africa he curtailed his last leave and travelled back to Tanganyika by car with a friend by way of Nigeria, French Cameroons, Belgian Congo, Ituri Forest, Kivu and Uganda, and of this he has left a graphic account. His love of fun, kindheartedness and fondness of children were evidences of a most attractive personality. Always abounding in energy and good spirits, he was exactly the man for the post, and his loss will be severely felt not only by botanical institutions in Britain but very specially by the Department of Tsetse Research. As a correspondent in the Territory writes: "I do not know how the Department will fill his place, for not only had he a unique knowledge of our country's flora, but he had to an unusual extent the gift of enthusing others". A. D. C.

THE above accounts of the loss which science in general, and East African science in particular, has sustained in the untimely deaths of Mr. Swynnerton and Mr. Burtt, have come from two writers who are in a far better position than I to appraise the magnitude of that loss. As one who has worked for the last thirteen years under the direction of the one and in constant close association with the other, I am glad of this opportunity to add a few words about them in their capacities as leader and colleague. Mr. Swynnerton, in addition to displaying the qualities which have been described above, so treated his staff that they one and all looked to him more as guide, philosopher and friend than as to an official superior; he was an inspiration to greater and ever greater efforts to achieve the objects for which his Department was created, and by his kindly appreciation of all efforts, even the smallest, made each feel that his contribution formed a vital part of the general scheme. He never asked from anyone more than he was prepared to perform himself, and his visits to lonely workers were like an invigorating tonic, difficulties which had previously seemed insuperable disappearing, for the time at least, under his magic touch. His work was inspired by a genuine love for the Africans in whose country he spent so much of his life and his treatment of them was characterized by a patriarchal attitude in the best sense of that word.

Mr. Swynnerton's qualities as a naturalist have been described; no less than he, was Mr. Burtt a lover of Nature, and a born observer; the great qualities of the latter in this respect, his delight in all such observations, and the enthusiasm which he gave to them, all combined to make him a companion whose presence not only lightened many an arduous day under the trying conditions of the tropics, but also increased beyond measure the profits gained from such toils; to travel with him through the African forests was an education, especially in the latter days as his own experience and knowledge grew. His eagerness to co-operate, his entire lack of selfishness, and the kindly enthusiasm with which he shared the fruits of his observations and experiences, often won at the expense of such arduous endeavour as one of lesser physical strength would have been incapable of exerting, made him the most valuable of colleagues, and one who inspired all with whom he came in contact with some measure of his own love of Nature. This led frequently to their stimulation to attempt similar observations on their own, so that his work was often extended and enriched beyond what he could have achieved alone. One who was ever impatient of red-tape, he found in his chief, Mr. Swynnerton, a sympathetic leader under whom his natural abilities could develop and flourish in a way which would have been difficult under the more rigid and stereotyped conditions so often associated with Government service.

The deaths of these two leave gaps in their Department which it will be impossible to fill entirely; their colleagues and friends suffer the bitter loss of two sources of inspiration and infectious enthusiasm which were a constant and quickening stimulus to them; the campaign against that plague of Africa—the tsetse fly—and the study of East African ecology in general, both so essential to the proper development of the latent resources of that country, are the poorer by the disappearance at one and the same time of an able and inspiring leader, and of a gifted and indefatigable worker, who both possessed in no small degree the power to stimulate others to contribute to the subjects in which they were themselves interested and which it was their main object in life to foster.

W. H. POTTS.

WE regret to announce the following deaths:

Lieut.-Colonel C. H. H. Harold, O.B.E., director of Water Examination, Metropolitan Water Board, on July 18, aged fifty-three years.

Miss A. T. Neilson, lecturer in geology in the University of Glasgow, on July 8.

Mr. E. M. Nelson, formerly president of the Quekett Microscopical Club and of the Royal Microscopical Society, an authority on microscopy and microscope construction, on July 20, aged eighty-seven years.

News and Views

Sir Gilbert Morgan, O.B.E., F.R.S.

SIR GILBERT MORGAN is retiring from the directorship of the Chemical Laboratory, Teddington, under the Department of Scientific and Industrial Research, and is taking over a directorship in another important field of work. He was appointed director at Teddington in 1925, but had held previously the professorship of applied chemistry at Finsbury Technical College, the professorship of applied chemistry at the Royal College of Science, Ireland, the professorship of chemistry at the University of Birmingham, as well as the post of assistant professor of chemistry in the Royal College of Science, London. At Teddington, he was entrusted with the task of creating something out of nothing, and was successful in establishing an institution which has become a valued national possession. For this he received the honour of knighthood in 1936. Before his administrative duties limited the time which even he could find for research, Sir Gilbert published many papers in the *Journal of the Chemical Society* and other journals. In fact, his invention of the word "chelate" in connexion with co-ordination led his friends to name this branch of organic chemistry "Morganic Chemistry". To the Chemical Society he gave his services as editor, secretary and president, and he has been president also of the Society of Chemical Industry. Sir Gilbert is one of those men who discreetly avoid giving the year of their birth in "Who's Who", but his age may be judged from the fact that he is now retiring under the usual Civil Service rules. He has the good wishes of all his friends in his new appointment and they are confident that the success which has crowned all his other activities will attend his new effort. Let us hope that, like Chevreul, he will have a medal struck in his honour on his hundredth birthday. Meanwhile, his "chelate" personal character will continue to attract the affection and admiration of all who come into contact with him.

Major F. A. Freeth, O.B.E., F.R.S.

MAJOR F. A. FREETH, who has been research manager of Imperial Chemical Industries, Ltd., since the formation of the company in 1926, is retiring from that position but has consented to continue his connexion with the company in the capacity of consultant. Major Freeth was educated at the University of Liverpool and at an early age gained considerable reputation as a physical chemist, becoming chief chemist to Messrs. Brunner Mond and Co. Ltd. in 1910. On the outbreak of the Great War, he went to France with the Cheshire Regiment, but was

recalled to England to undertake scientific work in connexion with the supply of munitions. He rejoined Messrs. Brunner Mond and for the remainder of the War he did very valuable work in developing new processes for the manufacture of explosives. For his services to the country he was honoured with the O.B.E. In 1924, Major Freeth was awarded the doctorate in the Faculty of Mathematics and Physics in the University of Leyden. He was elected a fellow of the Royal Society in 1925.

Mr. A. G. Lowndes

MR. A. G. LOWNDES, who for the past seventeen years has been a science master at Marlborough College, is retiring at the end of the present term. Few science masters in public or other secondary schools devote themselves to original research, or have their contributions to knowledge published by scientific societies, but Mr. Lowndes, like the late Mr. Edward Meyrick, who was for many years also a master at Marlborough, but on the classical side, has had a number of original contributions published in the proceedings of scientific societies and also in the columns of NATURE. In 1934 he was awarded a Leverhulme research fellowship for his cinema-photomicrography. Immediately after the British Association meeting at Cambridge next month, Mr. Lowndes is going to the Leper Settlement at Oji River, Onitsha, Southern Nigeria, as a guest of the Church Missionary Society, to stay with an old pupil, Dr. David Money, who is the medical officer in charge, and to see if useful work can be done there by a trained biologist. He proposes to return to England in the spring and to work at least eighteen months at the Marine Biological Laboratory at Plymouth, where he will apply his method of finding the density of living aquatic organisms to the study of plankton.

Society for the Protection of Science and Learning

MR. DAVID CLEGHORN THOMSON, formerly secretary to the Oxford University Appeal Committee, has been appointed general secretary, in succession to Mr. Walter Adams, of the Society for the Protection of Science and Learning (formerly known as the Academic Assistance Council) which for five years has been handling the academic side of the international refugee problem. Mr. Cleghorn Thomson is a graduate of the Universities of Edinburgh and Oxford; a senior history exhibitioner of Balliol, he was for seven years the B.B.C.'s chief official in Scotland. The Society for the Protection of Science and Learning, of which the Archbishop of York recently became president in succession to the late Lord Rutherford, acts as a central bureau of information regarding professors, lecturers and research workers displaced in their own country on account of 'race', religious or political opinions, and aids in securing the continuation of their valuable work in other countries. So far, of the 1350 displaced scholars registered with this Society, 520 have been permanently placed in 38 countries, apart from more than 300 who have temporarily found work. Within the last three months, the Society has received 340 applications from scholars who have had to discontinue academic activity in Austria. The offices of the Society are at 6 Gordon Square, London, W.C.1.

Atlantic Flight with 'Pick-a-Back' Start

Mercury, the seaplane upper component of the Short-Mayo composite aircraft, arrived at the airport of Boucherville near Montreal on July 21 at 12.20 p.m. Eastern Daylight Time, having flown from Foyne, County Limerick, in a little more than twenty hours. The actual time from shore to shore, Foyne to Cape Baulewn, Newfoundland, was 13 hours 29 minutes. Considerable rain and head winds were experienced during the flight, the machine arriving at Montreal with only about eighty gallons of fuel left. After refuelling, she took off for New York, reaching there about two hours later. Captain Bennett, the pilot, and Mr. Coster, the wireless operator, stated that they had experienced no unexpected difficulties during the journey, and had used their automatic pilot quite successfully as necessary. The machine carried a cargo of newspapers, newsreels, and photographs, principally of the royal visit to Paris. The newspapers were on sale in New York on the day following their publication. The successful finishing of this flight represents the completion of one of the experiments upon the problem of launching aircraft with excessive loading, due to the necessity for carrying considerable fuel and oil for long-distance flights. Other methods such as catapulting, topping up with fuel while in the air, etc., are being developed, and have been mentioned in NATURE as they have occurred.

Depredations of Property by Rabbits

A BILL to protect agriculture from the ravages of rabbits was introduced in the House of Lords by Lord Sempill on July 25. It follows the lines of the report issued by the Mersey Committee on this subject, and provides powers for enabling the county councils to take action against the owner or occupier of rabbit-infested land who fails to take precautions to prevent damage to neighbouring land. It also provides for action for damages on the part of the aggrieved party. To meet the difficulties of those who are unable to find the labour and equipment necessary for keeping down rabbits, the Bill enables county councils to provide staff and equipment for this purpose. Gin traps, however, are not to be used by the staff so provided. Some doubt has been expressed as to whether the destruction of rabbits by cyanide fumigation, which may now be regarded as the standard method of rabbit-control, is strictly legal, and a clause of the Bill puts the use of this method for rodents beyond doubt. The Bill also gives effect to the Mersey Committee's recommendation that "gin traps should in no circumstances be set in the open".

SPECIAL provision is made in the Bill for instances in which Scottish legal practice and administration differ from the English. The introduction of the Bill is in the nature of a reconnaissance and has been

undertaken in the hope that it may facilitate the passage next session of legislation on similar lines. The promoters have a two-fold objective; first, to bring some relief to farmers who are suffering from the depredations of rabbits coming from neighbouring property, and secondly, by reducing the stock of wild rabbits in the country, to reduce the amount of suffering inflicted annually by the rabbit-trapping industry. A leaflet written by a Bedfordshire farmer, with illustrations by a Bedfordshire farm labourer, has been issued in support of the Bill, and copies of this, together with a memorandum summarizing the details of the Bill, may be obtained from ULAWS (The University of London Animal Welfare Society), 42 Torrington Square, London, W.C.1.

Prehistory and Quaternary Geology of the Sahara

THE first international meeting for the Study of the Prehistory and Quaternary Geology of the Sahara was held under the auspices of the Musée de l'Homme, Paris, on June 27–30. Sir Robert Mond, who has arranged for the publication of the results, was *président d'honneur*, and Prof. P. Rivet, who kindly allowed the magnificent organization of his new Museum to be used, was president. Archæological papers predominated at the meeting, and of these the larger number dealt with the numerous and important rock-drawings and rock-paintings of the Desert. This being the first general meeting of men of science working in different areas of almost half a continent, it was more exploratory than definitive, the primary purpose being to familiarize workers with progress in other parts. Perhaps, not least important was the opportunity for personal contact. A second meeting will be held four years hence. However, certain more concrete results were obtained. Machinery was set up for forming a bibliography of rock paintings and drawings. It was agreed that in the *pré cameline* era two clear periods of rock pictures were to be found throughout the entire area, an early 'level' of hunters and a later one of cattle breeders. Further subdivisions appear at present to be local, and it also seems as if the hunters differed in different localities, whereas the cattle breeders were probably the same people throughout the Sahara. Furthermore, there was common accord that one *genre* of pottery is found throughout, though it varies slightly locally. The biggest uniform group stretches across the entire southern half and is the same as the Early *C*-Group culture of Nubia and a similar culture found by the Robert Mond Expedition at Armant. Its date of entry into Egypt is fixed at about 2500 B.C. The papers read at the meeting will be published later in full.

Iron Age Site in Wiltshire

THE experiment of the Prehistoric Society in undertaking excavation on an archæological site in Wiltshire, hitherto known only from air survey, with the view of providing at the same time a training ground for young archæologists (see NATURE, July 9, p. 65) has fully justified itself so far as concerns the archæological results, which, after a month's excavation, have proved of considerable interest. The site selected was the lesser of two enclosures at Woodbury on the hill south of Salisbury. A test excavation had shown that it had been thickly inhabited at a period definitely belonging to the Early Iron Age. According to a preliminary report (*The Times*, July 20) not only did excavation confirm the existence of the pits inferred from the evidence of the air survey, but it also revealed others not so indicated. Further study of conditions affecting the two groups will no doubt prove of value in the future development of the technique of air photography. In addition to isolated pits and post-holes, there is a large group of intercommunicating shallow pits appearing on the photographs as what has come to be known as "the Great Dark Mark". Finds included a blue bead of the Early Iron Age and quantities of Early Iron Age pottery. No Romano-British remains were found. The pits were evidently for storage; and the excavators conclude that such pits, with their vertical sides, cannot be regarded, as hitherto, as pit-dwellings. The burnt material adduced as evidence of hearths, it has been shown at Woodbury by intensive study *in situ*, was not formed in the pits, but was thrown into them. The discovery of a similar enclosure on a hill above Harnham about a quarter of a mile away leads to the suggestion that the site now occupied by Salisbury was surrounded by a ring of such enclosures. There are others at Cockey Down and north-east of the aerodrome at Old Sarum. The complicated nature of the site will probably necessitate a second season's excavation, although the duration of the present term of digging will depend upon the funds available, towards which contributions are needed. These may be addressed to the Hon. Treasurer, Department of British and Medieval Antiquities, British Museum, Bloomsbury, London, W.C.1.

Destructive Earthquake in Greece

ON July 20, about 2.15 a.m. Athens was shaken by an earthquake which lasted about 10 seconds, and probably had its epicentre in the Island of Eubœa (Negroponte) in the Ægean Sea. The depth of focus appears to have been normal (10–15 km.), and the area in which the earthquake was destructive was about 5,000 square miles. Eight villages near Oropos were seriously damaged, seventeen people were killed, and about eighty injured. There appears to have been some fault displacement near Halcoussie. No damage appears to have been done in the capital. Greece is well known to be a centre of seismic activity in historic times, though of recent years the epicentres have been chiefly about 38·5 N. lat., 22·5 E. long., which is north-west of Athens. Very close to the present epicentre was an earthquake which occurred on April 27, 1894, and which did damage over an area of 3,000 square miles. Permanent surface movement in this 1894 shock was for thirty-five miles along a well-known fault parallel to the Gulf of Eubœa. The ground to the north-east side of the fault was moved slightly to the north-west and depressed by varying amounts from place to place, but never greater than 5 ft.

Earthquakes in India

The Times correspondent from Bombay reports that several earthquake shocks have been felt daily between July 5 and July 9, with epicentres near Paliad, a town 64 miles from Bhavnagar, near the west of the Gulf of Cambay. Paliad is being deserted by its population of approximately 5,000 in consequence of these shocks. This area cannot be said to have been greatly affected by earthquake shocks in the past, and there is no record of one at all in Miss E. F. Bellamy's catalogue for the years 1913–1930. There was some destruction of property in this district at the time of the Great Cutch earthquake of June 16, 1819, which was attended by what was probably the greatest vertical surface displacement resulting from any earthquake in India. The ground to the north was uplifted by 15–20 ft., whilst that to the south was depressed between 10 and 15 ft. When further reports come to hand, it will be interesting to see whether this epicentre is a south-easterly migration of the great earthquake of more than a century ago, or whether it is purely a local surface phenomenon.

Science and Mankind

In his presidential address to the Society of Chemical Industry at Ottawa on June 20 on the relation of science to the world of to-day, Viscount Leverhulme reminded his audience that science recognizes no political frontiers and accepts as her servants those in all countries who are engaged in the search after truth and who are working to increase mankind's knowledge of natural phenomena. Discussing the relation between mankind and science, he suggested that possibly we ask too much of science and apply new methods in fields where they have only a limited application. The man of science approaches all problems with the one purpose by observation, measurement and comparison to discover truth. The quest is dispassionate, and though a utilitarian purpose or a commercial motive might inspire the research, that does not affect the scientific approach to the problem which characterizes the scientific worker. Nearly all the contributions of science to our comfort and welfare can be traced to the quest of knowledge for its own sake.

The scientist as such is not concerned with ethical and moral problems, or with the political issues which may surround developments arising from his work. When, however, so many scientific discoveries having a practical application can be used destructively as well as constructively, the significance of the remark made by Lord Leverhulme's father that the greatest problem in the twentieth century would be the man behind the machine becomes apparent. Lord Leverhulme, indeed, suggested that just as the ethical development of the human race has not reached the point where it can safely be given aeroplanes and high explosives, so the human mind, in the mass, has not reached the point when it can adjust itself to the new revelations of physical and astronomy. If mankind is to become worthier of the gifts and opportunities science is giving him, Lord Leverhulme suggested that we must depend on forces and guiding principles at present outside the range of science. Even psychology, which is giving us a deeper understanding of man's mind and emotions and behaviour, has its limitations, and man cannot impartially demand of science the answer to every question and expect of her the solution of every problem. We should abandon the conception of science as an invading army that has ravaged and laid bare the spiritual. In the daylight of true proportion and perspective, science should be welcomed as a friend by those who work for the progress of humanity in other spheres of life.

Science and Industry

The Messel Memorial Lecture of the Society of Chemical Industry for 1938 was delivered by Dr. L. H. Baekeland on June 21. Dealing generally with "Science and Industry", Dr. Baekeland sketched more particularly the growth of chemical industry first in Europe and then in the United States. The value of chemical industry was only fully realized in the United States with the outbreak of the Great War, and Dr. Baekeland described how Mr. F. P. Garvan's appreciation of the dependence of the United States on Germany for dyes, intermediates, photographic chemicals, medicinals, etc., led him to organize the Chemical Foundation, of which he remained president until his death. Any *bona fide* American chemical manufacturer or company can become a stockholder, but can only subscribe for a limited number of shares. Every stockholder has the opportunity of acquiring licences by paying royalties on any patents owned by the Foundation. The money thus collected is used for developing chemical education, research, and similar efforts for advancing knowledge in chemistry and for the development of chemical industries. Generous support is furnished to many societies for the advancement of science and industry and medical research. Garvan also recognized the possibility of much closer relations between chemical industries and agriculture, and instigated the formation of the National Farm Chemurgic Council to co-ordinate agriculture, industry and science. Few men, Dr. Baekeland considers, had more influence in the United States on science and industry than Mr. Garvan, and there is now a much wider appreciation of the importance of scientific research in industry.

International Astronomical Union

The triennial conference of the International Astronomical Union, representing 27 countries, will be held at Stockholm during the week August 3–10 under the presidency of Prof. E. Esclangon, director of the National Observatory of Paris. After the usual opening meetings, the conference breaks up into a number of committees at which astronomical problems, especially those calling for international co-operation, are discussed. Draft reports from no fewer than twenty-nine such committees have been distributed a month in advance to those attending the meeting. Among the topics to be discussed are standard notations in astronomy—a provisional list

of suggested symbols has been circulated in advance—air almanacs, the publication of classical works of astronomy which are untranslated or difficult of access, the sources of error in observations with meridian telescopes and the distribution of fundamental stars for observation to different observatories, co-operation in cinematography of solar prominences to cover longer intervals of time than are available for one observatory, wave-length standards in the laboratory and the solar spectrum, the zero point of photographic magnitude and colour index, problems of stellar statistics and the absorption of light in interstellar space. Reports will be received on the present position of the "Carte du Ciel", of the observations of Eros at the opposition of 1931 and of the observations of radio signals at 71 different observatories in the world scheme of 1933. General discussions will take place in the different special committees on the past and future co-operation in the observations of stellar parallaxes, proper motions, variable stars and novæ, radial velocities, solar phenomena and cometary spectra and magnitudes.

IT seems indicated from the reports that there may be discussions on such questions as the origin and maintenance of stellar energy, the hydrogen content of the sun and stars, the theory of the Fraunhofer lines, the source of the far ultra-violet solar radiation, problems of spectrophotometry (of interest to a wider circle than that of astronomers alone) and instrumental questions such as the use of the Schmidt camera, the aluminizing of mirrors and of pyrex matrices for gratings: the work of Prof. R. W. Wood on these lines suggests the ultimate replacement of prisms by gratings for stellar work. The reports of the committees give clear evidence that the conference will be helpful, stimulating and useful, and there is every reason to expect a good attendance from Europe and America. South Africa has recently rejoined the Union and will be represented. Among the less arduous features of the Congress may be mentioned visits to the Observatory at Saltsjöbaden and to the Planetarium, also an excursion to Uppsala. His Majesty the King of Sweden will give a reception at the Royal Palace. The general secretary of the Union is Prof. J. H. Oort, of the Leyden Observatory.

British Museum (Natural History): Acquisitions

THE two most important additions to the Mammal Section of the Zoological Department during the present month are—the bequest by the late Mr. Norman B. Smith of his collection of Rhodesian, East African, and Sudanese game trophies, and a collection of mammals from South-west Africa presented by Major P. H. G. Powell-Cotton and Mr. Christopher Powell-Cotton. An important addition to the Osteological Section is the skeleton of a Hunter's hartebeest (*Damaliscus hunteri*) from the Tana Valley. The increasing scarcity of this species makes this specimen of special value; it is the gift of Messrs. Rowland Ward. The Museum has acquired from Lieut.-Colonel F. M. Bailey, who has just vacated the post of British envoy to the Court of Nepal, a large collection of birds made in that country. There is still much to be learnt concerning the distribution of Himalayan birds. Many species found in the Eastern parts do not occur in the Western, and the question as to how far east or west in Nepal they extend will, to a great extent, be solved when Colonel Bailey's collection has been properly examined. A further valuable selection of Swiss minerals, numbering 618 specimens from 59 carefully recorded localities, has been presented to the Department of Mineralogy by Mr. F. N. Ashcroft. The Department has purchased a large portion of the oldest meteoric stone, the fall of which is recorded. It fell in 1492 at Ensisheim, Alsace, France. For a long time the meteorite, which originally weighed 236 lb., was suspended by a chain from the vault of the choir of the parish church of Ensisheim, Alsace.

Geological Museum: Recent Acquisitions

AMONG the recent acquisitions of the Geological Museum is a large geological relief model of the London basin, measuring about 10 ft. by 5 ft. This is constructed on a scale of 1 in. to a mile, vertical heights being exaggerated about six times, and it includes an area extending from Foulness in the east to the Vale of White Horse in the west, and from Baldock in the north to Leith Hill in the south. The model illustrates clearly the main synclinal structure of the London basin, from the chalk rocks of which London draws so much of its water supply. Details of this structure of the solid rocks are accentuated by the colouring of drift and other surface deposits by various shades of stipple superimposed on the solid geology. A second relief model just placed on exhibition illustrates the glacial lakes of Cleveland, on a scale of 1 in. to a mile. This reconstruction, which is based on the work of the late Prof. P. F. Kendall, shows the glaciers, ice-dammed lakes, and drainage system of the Cleveland area at the time of the maximum extension of the Pleistocene ice-sheets. Among the dioramas recently added to the displays is one of an Anglo-Iranian oil-field, presented by the Anglo-Iranian Oil Co. This is the second experiment in a type of diorama in which the foreground is cut away to a depth of several thousand feet to show the geology. Two diamonds of unusual crystal form from Atian Kama, Akim, Gold Coast, have been given by Mr. G. P. Ashmore. Some five hundred varieties of marble used in decorative work in western Europe are now being exhibited.

The Science Museum

THE report of the Science Museum for 1937 again directs attention to the urgent need for the rebuilding of the centre block and for the extension of the Library. Four years ago, the Advisory Council estimated that the book-stores would be filled by the end of 1938 and gave a warning that further storage room was essential. The Library is the most valuable of its kind in the country and great use is made of it by those engaged in research, and if it is to perform its functions properly it is necessary that books and periodicals should be arranged so that they can be issued to readers with the least possible delay.

It is to be hoped, therefore, that immediate steps will be taken to adopt the suggestions of the Advisory Council. The report refers with satisfaction to the general work of the Museum and the special exhibitions which have become a feature of its activities. With the advance of discovery, invention and industry it is unavoidable that the collections should increase rather rapidly, and there is every justification for the demolition of the old centre galleries and their re-erection in keeping with the eastern block.

Research on Potatoes

DURING the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 21, the chairman of the Council, Dr. R. N. Salaman, reviewed the Institute's work on potatoes during the past twenty years. The tests for immunity from, or susceptibility to, wart disease, has materially assisted the breeders' efforts towards raising only immune varieties; the critical examination of the many thousands of seedlings entered for these tests has led to a rapid elimination of useless varieties, and the work of the Potato Synonym Committee has resulted in the almost complete elimination of synonyms. The large-scale demonstrations at the Potato Testing Station, Ormskirk, have proved that it is possible for farmers in Great Britain to grow and maintain virus-free stocks for seed purposes. He estimated that the loss in yield in Great Britain alone from the use of virus-infected stocks for seed purposes is in the nature of a million tons a year. With regard to potato breeding, Dr. Salaman thinks it very unlikely that any outstanding varieties will be produced until new methods are introduced; breeding stocks require the injection of fresh blood by the use of wild tuber-bearing species of *Solanum*. In conclusion, Dr. Salaman stressed the importance of reorganizing and regularizing potato seed production, that being the basic element in potato culture and of the utmost importance in time of war. Our immediate need is a scientific organization of the industry from the production of seed at one end of the scale to the dish of potatoes on the table at the other. Virus disease and blight cost the nation about five million pounds a year; loss caused by the former could largely be avoided by the proper organization of the seed trade and further research might well eliminate the latter.

Scientific Aspects of Refrigeration

ON July 12, a conference on "Refrigeration" organized by the British Association of Refrigeration was held in the rooms of the Royal Society. On the previous day, meetings of the Technical Board and Commissions of the International Institute of Refrigeration were held at which eighteen countries were represented. The first paper to the Conference was presented by Dr. A. K. Balls of the Food Research Division, U.S. Bureau of Chemistry and Soils. It dealt with enzyme action in food products and at low temperatures. In the subsequent discussion Dr. L. J. Harris of the Nutritional Laboratory, Cambridge, Dr. Katherine Coward of the Pharmaceutical Research Laboratory, and Miss M. Olliver took part. Prof. Prescott of Boston presented a paper prepared by Messrs. R. R. Jenkins and D. K. Tressler of the N.Y. State Agricultural Experimental Station, Geneva, N.Y., and G. A. Fitzgerald of the Birdseye Laboratories, U.S.A., on vitamin C in vegetables: storage temperatures for frosted vegetables. Dr. Kidd of the Low Temperature Station, Cambridge, read in abstract a paper by himself and Dr. Moran on atmospheric control in the preservation of foodstuffs.

In the afternoon, the session was opened by a paper by Mr. Edgar A. Griffiths, South Africa, on the design and operation of large gas stoves. Following a brief discussion on air conditioning there were three contributions from Germany. Dr. Plank of Karlsruhe dealt with the ideal comparison cycle of refrigeration for international use. Dr. E. Altenkirch of Berlin read a report on an international unit of refrigeration, and Dr. E. Schmidt of Braunschweig discussed the question of preparing standard tables for the properties of refrigerants. The Conference was presided over by Dr. Ezer Griffiths and Mr. A. R. T. Woods, past-president of the British Association of Refrigeration. The papers in abstract and the discussions are being published in *Ice and Cold Storage* and other journals.

Leverhulme Research Fellowships

THE following Leverhulme research scholarships, among others, have recently been awarded for research indicated: Dr. W. Cule Davies (University College, Cardiff), organic compounds of nitrogen, phosphorus and arsenic; Dr. S. Goldstein (University of Cambridge), turbulent motion of fluids; Dr. F. C. Happold (University of Leeds), nutrition of the three types of *C. diphtheriæ* in its relation to toxin production; Dr. M. W. Jepps (University of Glasgow), structure and life-cycles of certain marine Protozoa; Dr. W. H. S. Jones (St. Catherine's College, Cambridge), Greek medicine and Greek thought from 500 to 300 B.C.; A. King (Imperial College of Science and Technology, London), leader of expedition to carry out a biological, geological and physical examination of Jan Mayen Island in the Greenland Sea; D. A. O'Duffy (Bahrein Petroleum Company), lubrication problems at high pressures and temperatures; Dr. O. A. Oeser (St. Andrew's University), the 'combined' method in the social sciences; Dr. G. B. B. M. Sutherland (Pembroke College, Cambridge), application of infra-red spectra to structural problems in chemistry and physics; Dr. W. Taylor (The Polytechnic, London), substitution mechanisms in aliphatic compounds; Dr. B. Thomas (London School of Economics and Political Science), post-War migration of population within the British Empire and as between the Empire and the rest of the world; Dr. W. H. Thorpe (Jesus College, Cambridge), physiology of African tropical Homoptera; R. Wilson (University College, Swansea), nature and position of the singularities of a function in relation to the coefficient theory of its Taylor series.

The Night Sky in August

THE moon is full on August 11^{d} at 6^{h} and new on August 25^{d} at 11^{h}. No star brighter than magnitude 5·3 is occulted this month. Lunar conjunctions with the planets occur as follows: August 12^{d} 7^{h} with Jupiter; August 16^{d} 5^{h} with Saturn; August 28^{d} 23^{h} with Venus. (In New Zealand and other parts of the southern hemisphere the planet is actually occulted by the moon.) Venus, the disk of which is slightly gibbous, is an evening star increasing slowly in brightness to its maximum (mag. — 4·3) in mid-October. On August 31, the planet is near the first magnitude star, Spica. Jupiter, visible throughout the night, is in opposition on August 21, when its distance from the earth is rather less than 373 million miles. Saturn, the ring system of which is fairly well open, rises about 21^{h} in mid-August. The distant planet, Uranus, now in Aries, is occulted by the moon on August 18; the occultation, however, is not visible from the British Isles, but is possible to observers in Canada. On August 15, α Lyræ is on the southern meridian at 21^{h} 0·5^{m}. This star, together with α Cygni and α Aquilæ, make a conspicuous triangle, with the Milky Way for a background. Between β and γ Lyræ, the Ring Nebula may be located with slight optical aid. The variable star Algol in Perseus is coming into convenient position for observation. Its variability may be observed about two hours before and after the following epochs: August 18^{d} 2^{h}; 20^{d} 23^{h}; 23^{d} 20^{h}. The Perseid meteors characterized by their yellowish colour, rapid flight and trains in their wake, reach a maximum about August 10. The above times are given in U.T.; add 1^{h} to convert to Summer Time.

Announcements

PROF. C. R. HARINGTON, professor of pathological chemistry, and Prof. W. W. C. Topley, professor of bacteriology and immunology in the University of London, have been appointed members of the Medical Research Council, in succession to Prof. A. J. Clark and Sir John Ledingham, who retire in rotation on September 30.

THE following elections to the Paris Academy of Sciences have recently been made: Prof. T. H. Morgan, For. Mem. R.S., director of the Wm. G. Kerckhoff Laboratories of the California Institute of Technology, Pasadena, foreign associate, in succession to the late Lord Rutherford; Prof. T. Levi-Civita, For. Mem. R.S., emeritus professor of mechanics in the University of Padua, foreign associate, in succession to the late Dr. G. E. Hale; Prof. E. G. Barrillon, professor of the theory of navigation in the Ecole d'Application du Génie Maritime, Paris, member of the Section of Geography and Navigation, in succession to the late Dr. Ch. Lallemand.

MR. J. J. MACGREGOR has been appointed advisory economist for the West Midland Province at the Harper Adams Agricultural College. Mr. MacGregor graduated in agricultural science at the University of Glasgow in 1928 and has since been continuously engaged in the study of the applications of economics to the problems of agriculture. He has held appointments in agricultural economics at Seale Hayne Agricultural College and the University of Cambridge, and for the past three years has been on the staff of the Oxford branch of the Dartington Hall Economics Research Department.

LIEUT.-COLONEL W. L. HARNETT, formerly professor of surgery in the Medical College, Calcutta, and recently reader in surgery at the British Postgraduate Medical School, has been appointed medical secretary to the Clinical Cancer Research Committee of the British Empire Cancer Campaign. The scheme of clinical cancer research, which has already commenced, will embrace approximately seventeen thousand fresh cases of cancer annually occurring in the teaching hospitals and the specialized hospitals of the London area and the hospitals of the London County Council and the Middlesex County Council.

THE Royal Astronomical Society recently decided to publish a small circular entitled *Occasional Notes*, containing short articles written in non-technical style. It is hoped that three or four a year will be issued; and they should prove useful to those Fellows who find the *Monthly Notices* too specialized to read with profit. The first number, June, 1938, contains an account of the minor planet Hermes, discovered on October 28, 1937, and also a description of the quartz clock developed at the National Physical Laboratory, Teddington. A similar clock for the Royal Observatory, Greenwich, is in process of construction.

THE third International Congress for Microbiology will be held in New York City on September 2–9, 1939. It is requested that those who contemplate attending the Congress should send their names to Dr. R. St. John Brooks, secretary of the British National Committee (Lister Institute, Chelsea Bridge Road, London, S.W.1).

THE fifteenth Annual Conference of the Association of Special Libraries and Information Bureaux will be held at Lady Margaret Hall, Oxford, on September 23–26. Joint Sessions with the International Federation for Documentation will be held on September 24 and 25. Further information can be obtained from the General Secretary, Association of Special Libraries and Information Bureaux, 31 Museum Street, London, W.C.1.

THE Joint Committee on Materials and their Testing is organizing a meeting which will be held at the Institution of Electrical Engineers on November 25 next under the auspices of the Institution to discuss non-destructive testing. The subject has been divided into three sections, namely: magnetic and electrical methods; X- and gamma-rays; acoustical and general methods. Each section will be dealt with by authorities from Great Britain, the Continent and the United States. The meeting will be held under the presidency of Dr. A. P. M. Fleming.

ERRATUM. In the inscription of Fig. 1*b* in Prof. Ruggles Gates' letter on "Chromosome Structure" in NATURE of July 23, page 157, the words "split satellite" written by him were, we regret, printed as "split chromosome".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 214.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Heat Transport in Liquid Helium below 1°

EXPERIMENTS by Pickard[1], which will shortly be published, have shown that the specific heat of liquid helium becomes roughly proportional to T^3 at about 0·9°–0·8°, that is, that the anomalous part of it has died out. This fact suggests that the other properties depending on the transition of atoms or groups of atoms into a state of higher energy—which is responsible for the λ-phenomenon—will also disappear in this region. The most conspicuous property of this type is the anomalous heat conduction which has lately been investigated by various authors[2]. The presumption that this anomalous conduction would vanish at very low temperatures was supported by a casual observation: we found that if a capsule[3] of the type used in magnetic cooling experiments contains insufficient helium to cover the salt completely, temperature differences within the capsule equalize only very slowly. One might have expected, remembering the well-known characteristics of liquid helium II found by Rollin[4], that a film of helium would cover the salt and bring about rapid equalization of temperature.

We have carried out some experiments on the heat conduction of the liquid in the following manner: two containers—each holding about 1 gm. of powdered iron alum—are connected by a capillary and this 'twin-capsule' is filled with liquid to a level above the salt in the upper part. The temperature of each part could be measured separately. As the heat capacities of the salt and helium are known, we could determine the amount of heat flowing from one part to the other, if a temperature difference between them was established either by a differential heat influx from outside or deliberately by radioactive heating. We used a capillary of 18 mm. length and 0·5 mm. diameter and worked with temperature differences not exceeding 0·1°. The experiments were restricted to the region between 0·2° and 0·5°, as experimental difficulties prevented us obtaining good results at higher temperatures. For reasons which we shall discuss in a detailed publication, the absolute value of the temperature may be wrong by about 10 per cent. If the results are expressed in terms of a heat conductivity ($\varkappa$), one obtains the following values:

$T°$	$\varkappa$
0·5	$2·2 \times 10^{-3}$ cal. deg.$^{-1}$ cm.$^{-1}$ sec.$^{-1}$
0·4	1·4 " " " " "
0·3	0·7 " " " " "
0·2	0·2 " " " " "

These values are of the order of magnitude of normal conductivities. To give an idea of the times necessary for obtaining a decrease of a temperature difference to its e^{th} part in our experimental conditions, we mention that they amount to about 1, 2, 7, 50 minutes at 0·5°, 0·4°, 0·3° and 0·2° respectively. (This is in agreement with a preliminary experiment carried out with Rollin[4b] using a wider capillary and less salt; see also the remark of Shire and Allen[5].)

Our value at 0·5° is smaller by a factor 10^4 than the smallest value measured by Keesom[6], and it appears impossible to obtain Keesom's figure by extrapolating our curve. This, as well as the fact that our values are nearly proportional to Pickard's 'normal' specific heats seems to justify the assumption that we are concerned here solely with 'lattice' conduction. Heat conductivity can be represented quite generally[7] as the product of a specific heat, a velocity and a mean free path. Assuming that in our case heat is transported by elastic waves, we can calculate from the specific heat and the velocity of sound[8] that the mean free path of these waves is of the order of 10^{-3} cm. Owing to the approximate proportionality of $\varkappa$ and C_v, it is nearly constant in the temperature region in question, a fact suggesting that the mean free path is determined by the disturbances due to the zero point energy. We shall investigate this point more quantitatively after having improved the apparatus. We shall examine also at which dimensions $\varkappa$ begins to be dependent on the diameter of the capillary, as this would provide an independent means of determining the mean free path[9].

These results obviously imply that a rapid transport of heat by means of films will also cease at the temperatures in question. (*Added in proof:* experimental confirmation of this has now been obtained.) It may be mentioned that the investigation of the film phenomenon at very low temperatures has the advantage that—owing to the minute pressures of the gas—transport of heat by evaporation and recondensation is excluded. It should be noted also that our results indicate that it should be possible to employ liquid helium below 0·1°—using, of course, appropriate dimensions—in order to establish, or cancel at will, thermal contact, which is impossible in the region of anomalous conductivity. This is important when working with a magnetic two-stage apparatus, as is necessary, for example, in trying to utilize nuclear paramagnetism in order to obtain still lower temperatures than can be achieved in the ordinary way.

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June 29.

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[2] See, for example, Keesom (ref. 6), Rollin (ref. 4), Allen, Peierls, Uddin, NATURE, **140**, 62 (1937); Cockcroft, *Nuovo Cimento*, **15**, 35 (1938).
[3] Kürti, N., Rollin, B. V., Simon, F., *Physica*, **3**, 266 (1936).
[4] Rollin, B. V., (*a*) Dissertation, Oxford (1935); (*b*) *Proc. VII. Int. Cong. Refrig.*, The Hague, **1**, 187 (1936); (*c*) Ref. 3. See also: Daunt, J. G., and Mendelssohn, K., NATURE, **141**, 911 (1938); and Kikoin, A. K., and Lasareff, B. G., NATURE, **141**, 912 (1938).
[5] Shire, E. S., and Allen, J. F., *Proc. Camb. Phil. Soc.*, **34**, 307 (1938).
[6] Keesom, W. H., Keesom, A. P., and Saris, B. F., *Physica*, **5**, 281 (1938).
[7] Debye, P., "Vorträge über die kinetische Theorie der Materie und Elektrizität" (Teubner, 1914), 50.
[8] Burton, E. F., NATURE, **141**, 970 (1938).
[9] Casimir, H. B. G., *Physica*, **5**, 495 (1938).

Specific Ionization of Gases by Soft Cosmic Rays, Residual Currents and Deep Water Measurements

IT was shown by J. Juilfs and V. Masuch[1] that the ionization by cosmic rays filtered at sea-level through 10 cm. lead is proportional to the gas density in the measuring chamber. The same property was found by us to exist in the case of the soft cosmic rays in the upper layers of the troposphere. The measurements were made during a balloon ascent on May 14 between 6 km. and 10 km. Two similar spherical ionization chambers were used, one filled with nitrogen, the other with krypton containing about 5 per cent of xenon. The gases were kept under 16·5 atm. pressure; Lindemann electrometers controlled by a Weston normal cell were employed. The results are shown in Fig. 1. By multiplying the ordinates of the lower nitrogen curve by the relative density of the gases, 3·06, one obtains points corresponding to the krypton curve. With radium C gamma rays I_{Kr}/I_{N_2} was found to be 5·3, which value differs widely from that for cosmic rays.

We would emphasize once more that neither in this flight nor in the flights of March 29, 1936[2] and June 18, 1936 did we find discontinuities such as those found by G. A. Suckstorff[3] and more recently by J. Juilfs[4]. This is why it seems to us difficult to admit the existence in the atmosphere of radioactive substances of extra-terrestrial origin. Not only are our curves continuous, the curve of computed mass absorption coefficients is quite smooth (Fig. 2), without any maxima, contrary to the results of W. Kolhörster[5]. Our curves are much steeper than those of Kolhörster.

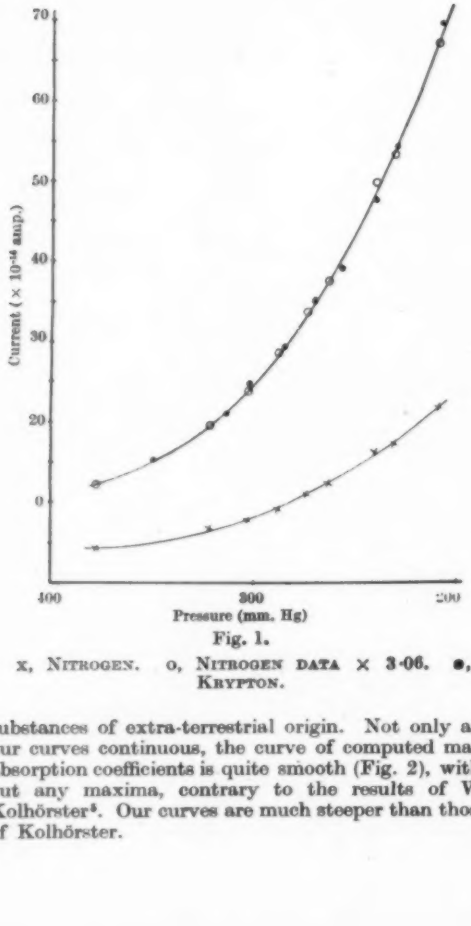

Fig. 1.

X, NITROGEN. O, NITROGEN DATA × 3·06. ●, KRYPTON.

The residual currents of the ionization chambers were checked by us in a rock-salt mine 406 m. deep at Wapno (Province of Poznań). This rock-salt mine is absolutely dry, almost free from potassium salts, and has a constant temperature of about 26° C. One of the ionization chambers was filled with argon at a pressure of 30 atm. It showed a residual current of about 1/320 of the value measured at earth surface. Thus we had at a depth equivalent to 900 m. of water a current of the same order of magnitude as that found by J. Clay[6] at the deepest point (270 m.) he reached in the Gulf of Aden. Our residual currents showed remarkably large irregular fluctuations; thus we think the anomalies found at great depths by J. Clay, as also those of A. C. Corlin[7], are not due to cosmic rays but to fluctuations of the residual currents. The accidental character of these abnormalities is best seen from inspection of the ionization curves, the rapid decrease of Clay's curve at 270 m. being absent on the curve of Corlin.

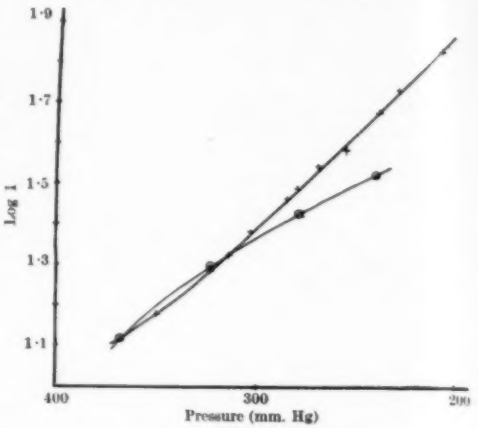

Fig. 2.

O, KOLHÖRSTER'S DATA; X, PRESENT AUTHORS' DATA

More detailed data concerning this work will be found in the paper which will appear shortly in the *Acta Physica Polonica*. All expenses connected with the observations were covered by the Committee of the First Polish Stratosphere Balloon Flight. Some apparatus was acquired, thanks to a grant obtained by one of us (S. Z.) from the Ministry of Education and the Mianowski Foundation.

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[1] Juilfs, J., and Masuch, V., *Z. Phys.*, **104**, 458 (1937).
[2] Ziemecki, S., and Narkiewicz-Jodko, K., NATURE, **137**, 944 (1936).
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[5] Kolhörster, W., and Tuwim, L., "Ergebnisse d. Kosm. Physik", 1 151 (Leipzig, 1931).
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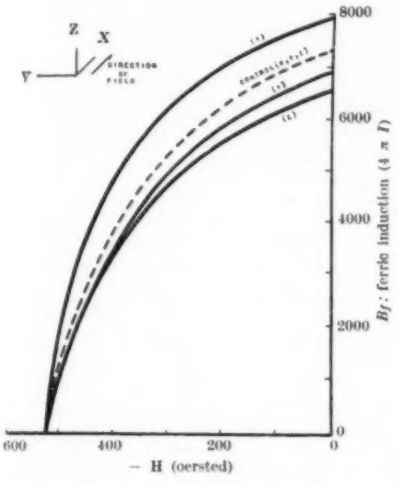
[7] Corlin, A., NATURE, **133**, 63 (1934).

Cooling of Permanent Magnet Alloys in a Constant Magnetic Field

THE investigations of Bozorth and Dillinger[1] show that very striking increases in maximum permeability may be obtained by applying a magnetic field to high permeability nickel-iron alloys during cooling. So far as we are aware, corresponding investigations have not been made on materials of high coercivity.

We have recently carried out experiments with positive results on permanent magnet alloys of the nickel-aluminium-iron Mishima type by cooling in a



unidirectional magnetic field from 1,200° C., and then measuring the demagnetization curves at room temperature. In general, we find the coercivity is not greatly affected, but that the remanence and the value of $BH_{max.}$ are increased. In the two directions at right angles, the results are practically identical with lowered values of remanence and $BH_{max.}$. Typical results for Alnico (nickel 18, aluminium 10, iron 54, cobalt 12, copper 6 per cent) are given in the accompanying graph, which refers to some experimental cubes of 4·0 cm. side. Care was taken to ensure that so far as possible similar thermal conditions were observed in making the control experiment.

In the direction of the field, the true $BH_{max.}$ value increased from $1{\cdot}5 \times 10^6$ to $1{\cdot}8 \times 10^6$, or 20 per cent. At right angles to the field direction it dropped to $1{\cdot}35 \times 10^6$, or 10 per cent. The field strength H was 4,400 oersted. If I_r represents the remanent intensity of magnetization, and I_0 the saturation intensity, at room temperature, then we have found the ratio I_r/I_0 to be 0·72 in the direction of the constant applied magnetic field, 0·61 transverse to the direction of the field, and 0·67 for the control with no applied field during cooling.

An interpretation of these effects can be offered on lines similar to that put forward by Bozorth and Dillinger in connexion with their results. On cooling a ferromagnetic below the Curie point and through the temperature range in which plastic flow occurs, the magnetostrictive strains are to some extent relieved, and the actual direction of magnetization of each domain becomes an energetically favoured direction of magnetization. These directions would normally be at random through the material as a whole; but if a field is applied during cooling, they will be so distributed as to favour subsequent bulk magnetization parallel or antiparallel to the direction of the original applied field. In the limit, the normal six or eight equivalent easy directions for each domain (for cubic structures) would be replaced by two, and (for a particular direction) the remanent magnetization would then be equal to the saturation magnetization.

This state may be nearly approached with high permeability material. With permanent magnet alloys, for reasons which are qualitatively clear, the effect is relatively small, but it is large enough to be of possible technological value, and the determination of its magnitude may contribute to a more quantitative theoretical treatment of the properties of these alloys in relation to their structure[2].

We wish to thank Prof. W. L. Bragg for his encouragement and for suggesting following up this line of investigation, and Dr. E. C. Stoner for helpful comments.

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June 28.

[1] Bozorth, R. M., and Dillinger, J. F., *Physics*, **6**, 279 and 285 (1935).
[2] Bradley, A. J., and Taylor, A., Magnetism, p. 89 (Institute of Physics, 1938).

Electrical Impedance of Nerve During Activity

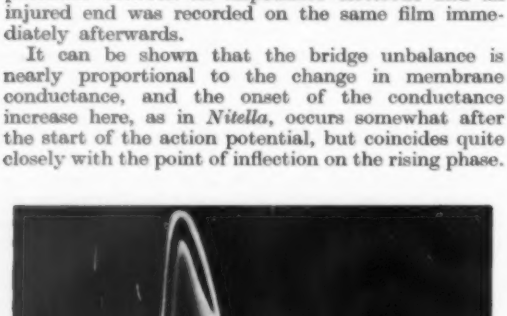
ALTERNATING current impedance measurements made over a wide frequency range show that the membranes of many living cells, including those of several nerve fibres[1], have electrical capacities of about one microfarad per square centimetre. The leakage conductance of the membranes of resting cells is small and there is considerable variation in the phase angle, which is assumed to be a measure of the dielectric loss. These same characteristics have been found from transverse impedance measurements, made with the current flow perpendicular to the cell axis, on the long single cell of the plant *Nitella*[2] and the giant nerve fibre of the stellar nerve of the squid, *Loligo pealii*[3].

Because of their large diameters, it has been possible to observe and measure, in both these cells, the change in transverse impedance during the passage of the wave of excitation, which is the nerve impulse in nerve and its analogue in *Nitella*. In *Nitella*[4], the membrane resistance falls from 10^4 ohm cm.^{2} or more to a minimum of about 500 ohm cm.^{2}, while the membrane capacity decreases fifteen per cent with its phase angle unchanged. In the squid nerve[5], the membrane resistance falls to about 100 ohm cm.^{2} and the capacity change is about a one per cent decrease without alteration of the phase angle.

The time course of the impedance change is very similar in the two cells, although the *Nitella* is a thousand times slower. For the squid fibre measurements, the amplified output of a Wheatstone bridge was applied to a cathode ray oscillograph which gave a narrow horizontal trace when the bridge was balanced and a sweep circuit moved the spot across the screen. In the accompanying illustration, the nerve fibre was stimulated at one end and the band

width is the record of a two per cent maximum unbalance of the bridge for a frequency of 20 kilocycles per second as the impulse came past the impedance electrodes. For reference, the action potential between an impedance electrode and an injured end was recorded on the same film immediately afterwards.

It can be shown that the bridge unbalance is nearly proportional to the change in membrane conductance, and the onset of the conductance increase here, as in *Nitella*, occurs somewhat after the start of the action potential, but coincides quite closely with the point of inflection on the rising phase.



IMPEDANCE CHANGE AND ACTION POTENTIAL OF THE SQUID GIANT NERVE FIBRE DURING THE PASSAGE OF A NERVE IMPULSE. INTERVAL BETWEEN TIME MARKS AT THE BOTTOM IS ONE MILLISECOND.

At this point, the membrane current density reverses in direction, corresponding to a decrease of the membrane electromotive force, so that this E.M.F. and the conductance are closely associated properties of the membrane, and their sudden changes are themselves, or are due to, the activity which is responsible for the propagation of the nerve impulse.

The capacity is probably a property of the ion-impermeable aspect of the membrane, while the conductance is due to the ion permeability. Since the maximum observed conductances are still far from a complete permeability, and because the capacity changes are relatively slight, we have indications that the excitation does not involve a disintegration or destruction of the membrane.

It is reasonable to suppose that similar changes occur in the membranes of smaller nerve fibres during excitation and the propagation of the nerve impulse.

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[1] Cole, K. S., and Curtis, H. J., *Cold Spring Harbor Symposia on Quantitative Biology*, **4**, 73 (1936).
[2] Curtis, H. J., and Cole, K. S., *J. Gen. Physiol.*, **21**, 189 (1937).
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[5] To be submitted to *J. Gen. Physiol.*

Reduction of Ions of Nickel, Cobalt, Iron and other Metals by Zinc Amalgam

THE statement that a metal will always displace any other metal below it in the potential series from solutions of its salts is well known not to be true in practice. As an example, the standard way of reducing ferric to ferrous ions in acid solution by zinc ought to fail because, according to the statement, reduction should not stop at the ferrous stage, as it does, but continue to the metal, zinc standing much higher in the potential series than iron. In general it has been found that, provided the displacing metal is not passive, ions of metals of the *B*-subgroup of the periodic classification conform to the simple statement and those of the metals iron, cobalt, chromium, molybdenum, and other 'special-steel' metals do not. Thus zinc instantly reduces to metal the ions of cadmium, thallium and tin, but not those of chromium, iron, nickel, and cobalt, although chromium and iron are close to cadmium in the potential series, and nickel and cobalt lie below both thallium and cadmium. The accepted explanation of this anomaly which preserves a belief in the potential series of metals is that with these ions the expected reaction is retarded or inhibited by causes involving the phenomena of passivity, over-voltage or polarization. Experiments we have done seem to show, however, that the main cause of the anomaly lies in the existence of a protective ring of groupings around what is ordinarily regarded as the simple ion of a 'special-steel' metal.

There is no doubt of the slowness of the reduction to metal of some ions. In dilute sulphuric acid solution, ferrous sulphate is at least a thousand times more slowly reduced by zinc amalgam than are cadmium or copper sulphate solutions under similar conditions. Nickel and cobalt sulphate are from one hundred to five hundred times more slowly reduced than cadmium or copper sulphate. This slowness does not seem to be primarily due to a metal surface or to the fact that the zinc is present as an amalgam or to reaction between a partially deposited metal and the electrolyte. Similar differences in the rates of reduction are found when there is no metal present at all, when, for example, a solution of ter-valent uranium sulphate or chloride is used. This is the most powerful common reducing agent available as a solution, and reduces cadmium ions in dilute sulphuric acid instantly to metal. Yet its effect on nickel and cobalt ions in dilute sulphuric acid is extremely slow, and on ferrous, divalent chromium, or ter-valent titanium ions it is apparently nil.

These observations suggest that the main cause of the slowness lies not in the reducing agent but in the state of the ions to be reduced. This was confirmed by a number of experiments on cobalt, nickel, iron, titanium and other metal ions. It was found that when nickel, cobalt or iron were in the form of complex anions, reduction to metal by zinc amalgam sometimes took place rapidly. Thus from solutions containing ammonium sulphate and ammonium hydroxide in excess, nickel and cobalt are as rapidly reduced to metal by zinc amalgam as in like conditions is copper. Again, from the blue solution of cobalt chloride in concentrated hydrochloric acid, where the anion is believed[1] to be $CoCl_4^{=}$, cobalt is reduced to metal from the moment the zinc amalgam is brought in contact with the solution. (This is proved by the marked catalytic effect of metallic cobalt on

the production of hydrogen from zinc and acid.) But the apparently simple cobalt ion of the pink, aqueous or dilute acid solution is not reduced when the complex anion is. As the former is believed[2] to be $Co(H_2O)_6^{++}$, it would appear that the groupings round the simple cation are the chief hindrance to the electrons which would convert the simple ion to metal atom. They guard the position which in the atom is occupied by the valency electrons. With complex anions, on the other hand, there is usually in equilibrium a small concentration of simple cation and this could be reduced to metal atom before it became ringed round with protective groupings.

That groupings surround the simple ions of metals like iron, cobalt, nickel, chromium, vanadium, titanium, etc., is on general grounds very probable. There is no difficulty in the reduction of any of the ions of higher state of oxidation of these metals. Quinque-, quadri- and ter-valent vanadium, for example, or ferric ion are, as is well known, easily reduced. But in these cases there are obvious vacant places inside the protected ion for the reducing electrons. It is at the final stage of reduction when the outer valency electrons have to be added that the protective effect of the groupings makes itself manifest.

From ammoniacal solutions, only nickel and cobalt were found to be reduced by zinc amalgam. From strongly acid solutions, nickel, cobalt and iron may all be obtained. The other metallic ions tried—those of titanium, vanadium, chromium, molybdenum and tungsten—were found not to yield more of the metal than was sufficient to show catalytic action on the evolution of hydrogen from zinc and acid, in confirmation of earlier work[3]. In general, the nickel and cobalt combine rapidly with the zinc to form compounds containing no mercury, of approximate formulæ ZnNi and ZnCo. The combination of iron with zinc occurs much more slowly. The product has the approximate formula $ZnFe_7$.

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Do Anthocyanins occur in Bacteria?

IT has frequently been stated that colouring matters of anthocyanin type are produced by bacteria, and as there does not yet appear to be any justification for this view, it may be desirable to correct an error which is finding its way into the text-books[1]. In most of the alleged instances of the occurrence of anthocyanins in micro-organisms, the description of the colouring matters and that of their reactions does not afford a *prima facie* case for their identification as members of the anthocyanin group, and there exists no example of the isolation and characterization from such sources of a substance which is undoubtedly an anthocyanin. Two publications, however, require more serious examination.

A. E. Kriss[2] has described a pigment of *Actinomyces Waksmanii* which is red in acid, blue in alkaline solution, and in these and other respects exhibits a superficial resemblance to an anthocyanin. We have made a culture of this or a closely related organism (probably *A. violaceus-ruber* Waksman), and from this have isolated in a crude form a pigment tallying in all respects with the description of Kriss. The substance is not a glucoside and undoubtedly shows considerable superficial resemblance to an anthocyanidin (for example, malvidin chloride). It is, however, definitely not an anthocyanidin, and the conclusive proof of this is that its solution in aqueous sodium hydroxide is perfectly stable and maintains a pure royal blue colour after boiling for a considerable time. No substance containing a flavylium nucleus will withstand such treatment; the heterocyclic nucleus is invariably quickly ruptured by the action of strong alkalis with the formation of orange or yellow polyhydroxychalkone derivatives.

It should be noted that the chemistry of the flavylium salts, in so far as it relates to their behaviour in acid and cold alkaline solutions, is naturally very similar to that of other classes of basic dyes, such as the oxazines, thiazines and azines, which contain a suitably constituted heterocyclic nucleus associated with hydroxylated benzene rings. Thus a polyhydroxyphenazine might simulate an anthocyanidin in respect of its indicator reactions, and there is little reason to doubt that this interesting pigment of Actinomyces is derived from one of these more stable types.

It has also been claimed[3] that, when *Bacillus citrulli* Sartoryi is cultured in a synthetic medium containing glucose and asparagine as sole sources of carbon and nitrogen, a triglucoside of pelargonidin is formed. The pigment was isolated and analysed and the aglucone, supposed to be pelargonidin chloride, was also analysed, the results tallying closely in both cases with those demanded by theory. Nevertheless, there are certain features of the description that suggest that this identification is erroneous and no direct comparisons were instituted; the absence of nitrogen was assumed after the failure of a qualitative test.

The object of this note is to emphasize that there is, as yet, no clearly proved case of the occurrence of anthocyanins in micro-organisms.

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[1] Cf., for example, Buchanan and Fulmer, "The Physiology and Biochemistry of Bacteria" (London, 1928); and Anderson, "An Introduction to Bacteriological Chemistry" (Edinburgh, 1938).
[2] *C. R. Acad. Sci. U.S.S.R.*, **4**, 283 (1936); *Brit. Chem. Abstr.*, A., 99 (1937).
[3] Sevenet, J., Thesis, Strasbourg (1935).

Œstrogenic Activity of Esters of Diethyl Stilbœstrol

IT is a well established fact that the esterification of naturally occurring œstrogenic substances such as œstrone and œstradiol causes a marked alteration in their biological activity, particularly with regard to the duration of their action. It was therefore decided to investigate the biological activity of various double esters of the synthetic œstrogenic agent diethyl stilbœstrol previously described by us[1].

The quantity of material administered was dissolved in 3 c.c. of sesame oil and given night and morning on three successive days to ovariectomized, inbred Wistar rats. Smears were taken after the third day and at intervals as long as œstrus persisted. From the accompanying table, it can be seen that esterification reduces the activity but that the effect

is prolonged. It would appear that the maximum prolongation without undue reduction in activity resides in the dipropionate. The very great prolongation of œstrus occurring when large doses of the dimethyl ether of the compound are administered is noteworthy. The œstrus appears to be almost indefinitely prolonged.

It will be observed that there is a very considerable difference between the action of double esters of œstradiol and those of diethyl stilbœstrol. In the former series, maximum prolongation of œstrus occurred with the esters of the higher fatty acids[2].

Name of substance	Melting point	Quantity injected (gamma)	No. of days in œstrus
Di-ethyl stilbœstrol	171°	1	4
		5	4
		10	5
Di-ethyl stilbœstrol di-acetate	124°	1	0
		10	21
" " di-propionate	104°	10	50*
" " di-*n*-butyrate	88°	10	10
" " di-*iso*-butyrate	86–87°	10	4
" " di-*n*-valerate	89°	10	2
" " di-phenyl-acetate	100°	10	4
		50	30
" " di-benzoate	210–211°	10	0
		100	30*
" " di-palmitate	77–78°	50	2
		100	30*
" " di-methyl ether	124°	50	2
		1000	126*
		6600	180*

* Rats still in œstrus

The esters were prepared by the action of the appropriate anhydride on diethyl stilbœstrol, usually at 100°, or by the Schotten-Baumann reaction (dibenzoate, diphenylacetate).

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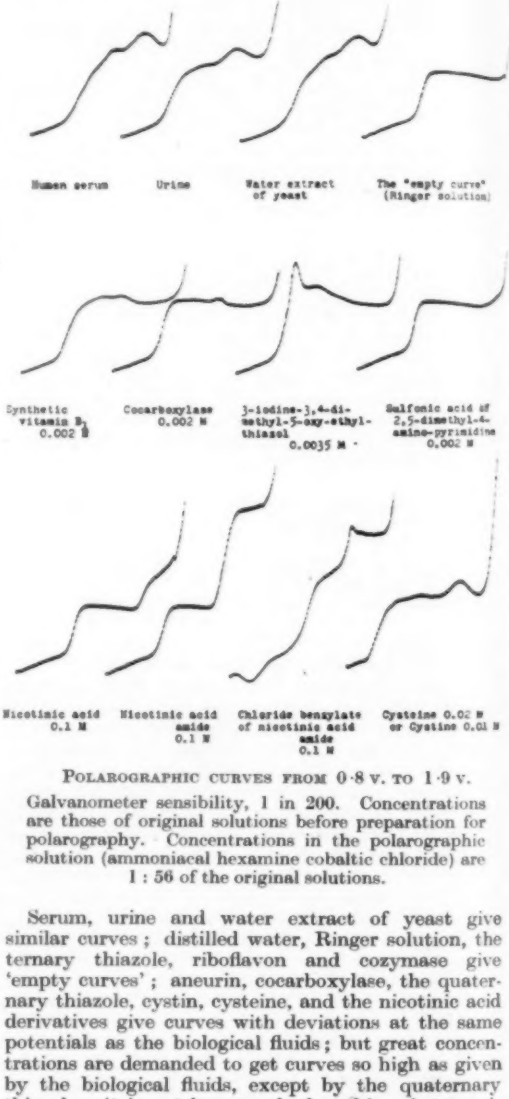
[1] Dodds, Golberg, Lawson and Robinson, NATURE, **141**, 247 (1938).
[2] Miescher, Scholz and Tschopp, *Biochem. J.*, **32**, 725 (1938).

Prague Sero Reactions for Cancer

DURING investigations of the Prague sero reactions for cancer we have tried to identify the substances in the serum, which give the typical polarographic curve when using the technique of Brdička described in our previous letter as preparation (*b*)[1]. According to Brdička[2], this curve form is characteristic for compounds of cystine; the concentration of cystine must, however, be 100–1,000 times greater than that generally found in serum (1 mgm. per cent[3]), if it is to be responsible for the heights of the curve, found by Brdička and ourselves in serum. Furthermore, we have found similar curves by submitting urine to the polarograph instead of serum, and we find that the concentration of cystine in normal urine is exceedingly small.

The sulphur-containing glutathione and methionine are scarcely of importance, as serum gives a stronger reaction than full blood. The thiazol aneurine (vitamin B_1) might be of importance; it is present in serum and urine; and a water extract of yeast was found to give curves quite similar to those from serum and urine (see accompanying graph). We therefore examined the pure components of the vitamin *B*-complex: synthetic aneurin, cocarboxylase, the thiazole part of aneurin as methylated iodide (=quaternary nitrogen), the naked thiazole part (=ternary nitrogen), the pyrimidine part of aneurine as sulpho-salt, nicotinic acid, nicotinic acid amide (=ternary nitrogen), nicotinic acid amide as benzylated chloride (quaternary nitrogen), cystine, cysteine, riboflavon (=vitamin B_2), cozymase, distilled water and Ringer solution. Examples of the results are given in the graph.


Human serum
Urine
Water extract of yeast
The "empty curve" (Ringer solution)
Synthetic vitamin B1 0.002 M
Cocarboxylase 0.002 M
3-iodine-3,4-dimethyl-5-oxy-ethyl-thiazol 0.0035 M
Sulfonic acid of 2,5-dimethyl-4-amino-pyrimidine 0.002 M
Nicotinic acid 0.1 M
Nicotinic acid amide 0.1 M
Chloride benzylate of nicotinic acid amide 0.1 M
Cysteine 0.02 M or Cystine 0.01 M

POLAROGRAPHIC CURVES FROM 0·8 V. TO 1·9 V.

Galvanometer sensibility, 1 in 200. Concentrations are those of original solutions before preparation for polarography. Concentrations in the polarographic solution (ammoniacal hexamine cobaltic chloride) are 1 : 56 of the original solutions.

Serum, urine and water extract of yeast give similar curves; distilled water, Ringer solution, the ternary thiazole, riboflavon and cozymase give 'empty curves'; aneurin, cocarboxylase, the quaternary thiazole, cystin, cysteine, and the nicotinic acid derivatives give curves with deviations at the same potentials as the biological fluids; but great concentrations are demanded to get curves so high as given by the biological fluids, except by the quaternary thiazole; it is not known whether this substance is present in the free state in blood and urine.

The polarographic curves in the cancer reactions must be an additive expression of the substances mentioned plus something not yet elucidated. The substance must be rather stable if we may take the polarographic curve as a criterion; it can stand boiling for hours in open vessels; it cannot be extracted from acid, neutral, or alkaline urine by shaking with chloroform, benzene, petrol, carbon tetrachloride, trichlorethylene, or olive oil. By fractional addition of methanol, ethanol, or acetone, the substance seems to be adsorbed to the precipitates in proportion to their amounts. It can be adsorbed (though not quantitatively) on fuller's earth at *p*H 4·6 and regained by elution at *p*H 7 by pyridine.

The substance in serum does not pass a 'Cellophane' membrane; the substance in urine passes a 'Cellophane' membrane, but very slowly.

Bile (from necropsies) gives very low curves and cerebrospinal fluid (from patients) gives almost 'empty' curves.

In a recent paper, Waldschmidt-Leitz[4] puts forward the view that the 'cancer substance' in serum may be a sulphur-free mucoid; we can confirm his experiments with fractional precipitation with ethanol, but our experiments with urine scarcely support the mucoid hypothesis, as normal urine does not contain mucoids and mucoids do not pass 'Cellophane' membranes.

We wish to thank Dr. Fritz Lipmann, of the Biological Institute, Carlsberg Foundation, who kindly sent us some of the synthetic compounds.

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Bergh, Henriques, Schousboe, NATURE, **141**, 751 (1938).
[2] Brdička, *Acta internat. Verein. Krebsbekämpfung*, **3**, 13 (1938).
[3] Brown, Lewis, *Proc. Soc. Exp. Biol., Med.*, **38**, 487 (1937).
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Two Active Proteins from Rattlesnake Venom

WE have found the dry venom of the Brazilian rattlesnake (*Crotalus t. terrificus*) to contain about 60 per cent of a neurotoxic substance and about 10 per cent of a blood coagulating principle. The latter shows all the proteolytic as well as all the coagulating activity of the crude venom. It was not possible to obtain this protein in a homogeneous state or to crystallize it, but we were able to achieve in the best case a tenfold increase of activity. Since the blood coagulating and the proteolytic activity was always found in the same fraction, even when prepared in different ways, we believe that these two activities are due to the same protein. It can be obtained by saturating the venom solution to 40 per cent with ammonium sulphate, whereby it is precipitated adsorbed on inactive globulins. When removing the ammonium sulphate by dialysis, these globulins separate out and the supernatant solution contains the coagulating substance. It can be obtained as a colourless material on evaporating the water in the high vacuum after freezing. We were able further to purify the coagulating principle by redissolving it in distilled water and centrifuging off the undissolved material. Once it is highly purified, it shows the properties of an albumin. It can also be isolated from the mother liquors of the preparation of the neurotoxic principle.

This neurotoxic substance we could obtain pure and in the crystalline state, as will be described elsewhere in detail[1]. It is the first proteinic toxin which has so far been crystallized. It contains the whole neurotoxic and the whole hæmolytic activity of the venom. These two properties of many snake venoms have hitherto been attributed to two different substances, one an enzyme, the other a toxin. This substance we called *crotoxin* (*Crotalus t. terrificus toxin*). Crotoxin can be isolated from the fresh venom secretion by heat coagulation, precipitation at the isoelectric point and ammonium sulphate fractionation. Crotoxin crystallizes from pyridine acetate solution in thin quadratic plates which aggregate in very characteristic manner (see accompanying illustration). Repeated recrystallization does not alter the physiological properties or the analytical data.

CRYSTALLINE CROTOXIN. ×96.

The analysis shows crotoxin to contain 4·0 per cent of sulphur, which is more than in the crude venom. It has been previously shown[2] that the sulphur in all venoms investigated here is bound at least partly in the form of −S−S-bonds, and that an opening of these linkages by reduction with cysteine (−SH) inactivates the venoms just as is the case with insulin.

We have therefore determined the quantitative distribution of the sulphur in crotoxin, and found the following facts[3]: the cystine content of 13·2 per cent corresponds to 87·4 per cent, the methionine content of 1·36 per cent to 7·3 per cent of the total sulphur. The cystine value is the mean of eight determinations using the Folin, Sullivan and Baernstein methods. All agreed within 0·3 per cent. From the methionine value, which is the mean of three determinations agreeing within 0·05 per cent, a minimum molecular weight of 11,000 can be calculated. The molecular proportion of methionine to cystine is exactly 1 : 6. One is tempted to believe that the actual molecular weight will be three or six times 11,000. A molecule of the weight 33,000 would contain eighteen cystines, three methionines and possibly two more sulphur-containing units which, however, cannot be disulphides, thiols, homologues of methionine or thiolactones.

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[1] Slotta, K. H., and Fraenkel-Conrat, H., *Ber. dtsch. Chem. Ges.* (1938).
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[3] Slotta, K. H., and Forster, W., *Ber. dtsch. Chem. Ges.* (1938).

Low-Voltage Electron Diffraction Tube

A SEALED-OFF cathode ray tube for demonstration of electron diffraction patterns at low voltages (6,000–7,000 volts) has already been described by me[1]. We have recently carried out experiments with this tube at lower voltages and have found that the electron diffraction patterns are quite visible on the fluorescent screen down to 4,000 volts and just visible down to 2,000 volts. Photographic records of electron diffraction patterns could therefore be made using electrons of only 2,000 volts energy.

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[1] *J. Sci. Inst.*, **15**, 138 (1938).

Definition of Research Department Administration

I HAVE no desire to resuscitate or discuss law court cases in the correspondence columns of NATURE; but in the summing up of a recent case, which many readers of NATURE will have followed, the judge made the following statement: "Nobody suggested that [the plaintiff] was anything but a thoroughly, perhaps exceptionally competent person in his scientific work, but [the defendants] said that his incompetence lay in his failure to administer his department properly, that is, to keep an eye on finance and to see that the machinery of the department was running with reasonable smoothness" (*The Times*, July 22, 1938).

Quite independently of this particular law suit, and with no implication in respect of the judgment, I think that most lay readers would infer that this represents a correct and adequate definition of the duties in research department administration. It will be sufficient in NATURE to mention the framing of research policies, allocation of problems to the right people, co-ordination, inspiration and the maintenance of a happy atmosphere as among the prime functions of the head of a department as such. Moreover, the evidence in this case indicated that this extended definition was applicable to the department in question. My principal point, however, is that there is a widespread tendency to regard administration as merely the supervision of office routine. Any unnecessary perpetuation of this fallacy is highly injurious to efforts that are being made in connexion with administrative education, which, as this case so lamentably indicates, can be needed by both employers and employed.

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Points from Foregoing Letters

EXPERIMENTS with liquid helium at temperatures between 0·2° and 0·5° K. indicate, according to Dr. N. Kürti and Prof. F. Simon, that the anomalous heat conduction and probably the surface film flow vanish at these very low temperatures.

Prof. S. Szczeniowski, Prof. S. Ziemecki and Dr. K. Narkiewicz-Jodko have measured during a balloon ascent ionization by cosmic rays at heights from 6 to 10 km. Nitrogen and krypton ionization chambers, each filled with gases under pressure of 16·5 atm., were used. The ratio of intensities of ionization in krypton and in nitrogen is equal to the ratio of densities of these gases. The curves obtained show no irregularities, which is contrary to the results of some German authors. A residual current in the above chambers observed at a depth equivalent to 900 m. of water shows very marked fluctuations which may help to explain the anomalies of ionization by cosmic rays at great depths found by Clay and Corlin.

D. A. Oliver and J. W. Shedden find that, on cooling permanent magnet alloys of the nickel-aluminium-iron Mishima type in a unidirectional magnetic field, the coercivity is not greatly affected but the remanence and the value of $BH_{max.}$ are increased; they suggest an interpretation of the results.

Prof. K. S. Cole and Dr. H. J. Curtis have shown that there is a decrease in the alternating current impedance of the giant nerve fibre of the squid during the passage of a nerve impulse. Analysis of the change shows that it is due to a decrease in the membrane resistance without an appreciable change in the membrane capacity.

Dr. A. S. Russell and J. C. Carver have investigated the reduction of solutions of nickel, cobalt, iron and other similar metals by zinc amalgam. They find that reduction to metal occurs very much more readily from complex anions of these metals than from the cations. They reject the view that the slowness of reduction of the cation is primarily due to a surface action at the reducing metal, and ascribe it to the existence of protective groupings surrounding the apparently simple cations.

D. Erikson, Dr. A. E. Oxford and Prof. R. Robinson find that the pigment of *Actinomyces Waksmanii* maintains its blue colour when boiled in alkaline solution, and cannot, therefore, be an anthocyanin. No anthocyanin, they state, has yet been definitely demonstrated in any bacteria.

A table showing the biological activity of various double esters of the synthetic œstrogenic agent diethyl stilbœstrol is given by Prof. E. C. Dodds, L. Golberg, W. Lawson and Prof. R. Robinson. Large doses of the dimethyl ether prolong the œstrus almost indefinitely.

Polarographic curves (potential changes at a dropping mercury electrode) of various substances are given by F. Bergh, Dr. O. M. Henriques and C. G. Wolffbrandt. They conclude that the curve previously obtained with cancer serum is due to a mixture of substances. One of these can be adsorbed on fuller's earth and re-extracted by pyridine.

A crystalline toxic protein (crotoxin) of molecular weight 11,000, or possibly 33,000, has been obtained from the venom of the rattlesnake by Prof. K. H. Slotta and H. Fraenkel-Conrat. Another active constituent of this venom which has proteolytic and coagulating activity has been separated in a tenfold increased concentration.

Research Items

Stone Age Correlations in South Australia

THE stone age of Kangaroo Island, off the coast of South Australia, has been studied by Mr. Norman B. Tindale (*Records, S. Australian Mus.*, **6**, 1; 1937) with a view to its place in the mainland sequence and its relation to the stone ages of Tasmania, Sumatra and Malaya. In the course of a search for stone age sites on Kangaroo Island, however, a number of implements were found of a type differing from those of the indigenous culture, which it was concluded were of Tasmanian origin and had been made between 1819 and 1836 by Tasmanian women introduced on the island by white men. They belong to the later of the two phases differentiated in Tasmanian culture. The Kangaroo Island stone industry includes a number of types, including 'sumatras', an elongated pebble core implement, so-called here from its resemblance to an implement of the Upper Palæolithic series of Sumatra and the Malay Peninsula, a discoidal flake implement resembling, but distinct from, the Central Australian *arapia*, the 'horse-hoof', hammerstones and simple flakes. Implements of the Kangaroo Island type have been found on sites on the mainland, such as at Balcoracana Creek, and on the old land surface at Fulham. Types resembling those of Fulham have been discovered at Hallett Cove. Similar implements come from Tasmania, possibly from sites on which the usual Tasmanian types are not found. It thus becomes evident that the Kangaroo industry belongs to an old culture having affinities with the Upper Palæolithic of Malaya. A tentative correlation with the succession which has been established on the Murray River suggests that it may be similar to the culture brought to Australia from Malaya by the first native visitors, and that these may have been the ancestors of the Tasmanians.

People and Culture in Pukapuka

A COMPREHENSIVE study of the ethnology of Pukapuka, Cook Islands, since 1914 under the administration of New Zealand, has been made by Ernest and Pearl Beaglehole, on a Bishop Museum fellowship (Bernice P. Bishop Museum, Honolulu, *Bull.* **150**, 1938). The population of the Island in 1935 was 632. In 1904 it was 435, since when it has increased consistently except in 1916, when a drop in numbers was due to the effects of a tidal wave. Records for 1933 and 1934 show a total of 41 births as compared with 22 deaths. Anthropometric measurements were made on 230 living, and have been forwarded to Dr. H. Shapiro for examination. The amount of racial or early inter-island admixture is not great. The stature for men and women is less than for other Polynesian groups. Face type seems to vary between a narrow, long face with long nose, and a wide face with short broad nose. It is possible that analysis will reveal two physical types based on this distinction. Skin colour is light brown, becoming very dark on exposure to the sun. Little sex differentiation is observed in motor habits. Although social structure has not been much affected by cultural contacts, except in regard to the power of the chief, behaviour has been made, outwardly at least, to conform to missionary standards. This gave rise to certain difficulties in the way of investigation, which, however, ultimately were overcome. The importance of this lies in the fact that for the Pukapukan all activities led naturally to sex. Whatever the purpose of a chant, all come sooner or later to the fact of sex, and triumphs and skill were woven harmoniously into a context that stressed the greatest joys of Pukapukan life. It is important to stress the simplifications inevitably introduced by the limitations of an atoll environment. This is most noticeable in material culture (witness the absence of bark-cloth manufacture), but environmental influence also affects social organization. Absence of kava means the non-development of elaborate kava ceremonial. Limitations in food resources means that much time must be spent by both men and women in procuring food. There are, therefore, no leisured chiefs, who could afford the luxury of supporting skilled artisans and craftsmen.

Insect Vectors of Beet Curly-Top Virus

THE relations between a virus and its insect vector are complex, and but little understood at present. Messrs. C. W. Bennett and Hugh E. Wallace have studied the transmission of the curly-top virus of sugar-beet by the leaf-hopper, *Eutettix tenellus*. They publish some interesting and illuminating conclusions in a recent paper (*J. Agric. Res.*, **51**, 1, 31; Jan. 1938). *E. tenellus* is the only vector of curly-top virus in North America, though other insects feed readily upon the beet plant. The virus is shown to enter the bodies of all these insects; but the vector species is the only one which can re-infect. Virus is present in the blood and the salivary glands of *E. tenellus*; but the available evidence suggests that no multiplication of virus takes place within the insect. Experiments on transmission of the disease by fasted insects are reported. The results would seem to show inactivation of the virus by one of the digestive enzymes secreted by the insect. Many other findings are given, and the paper opens several hopeful lines for further research.

The Soybean in South Africa

DR. J. VILJOEN has recently published an interesting analysis of the possibilities of the soybean for South Africa (*Sci. Bull.*, No. 169, South African Dep. Agric. and Forestry). Pointing out the great increase in the cultivation of this bean in the United States (in 1921 the area under soybeans already exceeded three million acres, representing probably "the greatest change in an agricultural practice in the history of Corn Belt Agriculture"), Dr. Viljoen emphasizes the fact that the bean may act as a restorative crop adapted to local conditions which can be grown in rotation with maize. A study was therefore made of the composition of the most important South African variety and of their expressed oils. The oil proves to be nearly identical with that from the American bean. Soil fertility seems to have little influence on the composition of the bean; on the other hand climatic effects are considerable, minimum temperature influencing considerably both the percentage of oil and the protein content. The effects of various fertilizers upon the yield and composition of the soybean are also analysed very fully.

Pasture Improvement in Australia

THE recent issue by the Australian Council for Scientific and Industrial Research of two publications (Melbourne: Government Printer) dealing with different aspects of pasture improvement, illustrates the importance attached to the subject in the Commonwealth. Pamphlet No. 77, "A Study of Persistency, Productivity and Palatibility in some Introduced Pasture Grasses" by A. McTaggart, gives an account of the characteristics of some thirty-four varieties or strains of grasses obtained from other countries. The climatic regions of Australia vary so widely that contacts have been established all over the world on the chance of finding some strain, the introduction of which would materially benefit the native pastures, the northern areas in particular being in need of some such improvement. The second publication (Bull. 116) "The Relation of Phosphate to the Development of Seeded Pasture on Podsolised Sand", is by H. C. Trumble and C. M. Donald. This report discusses work forming a part of a co-operative programme of investigations carried out by the Waite Agricultural Research Institute, the Carnegie Corporation of New York and the Australian Council for Scientific and Industrial Research. Pasture establishment in South Australia depends largely on an increase in the available phosphate content of the soil, together with seeding of suitable legumes and grasses. Podsolized soils, due to their excessive leaching, are specially low in available phosphate and nitrogen, and the investigations described in the bulletin show that the dressings of superphosphate usually given should be considerably increased if the maximum economic returns of the subterranean clover pastures are to be realized. 2 cwt. of superphosphate per acre annually for the first three years is recommended. The incorporation of grasses into the clover pastures is also discussed.

Vegetative Propagation in Leafy Liverworts

W. DEGENKOLBE has recently surveyed the various organs serving for vegetative reproduction in the foliose liverworts (*Annales Byologici*, **10**; 1937). Deciduous branches and thallose outgrowths are new types not previously described. The author finds the type of vegetative propagation very characteristic and often of greater systematic significance than details of the perianth. Gemma production is associated with leaves of a definite age, and the effect on leaf production is characteristic of the type of gemma produced and upon the species. In some cases, the same species may develop more than one kind of organ for propagation, for example, deciduous leaves and marginal gemmæ; in some the production of deciduous leaves is periodic. Vegetative propagation in this group is not antagonistic to the production of sexual organs. The paper also includes a discussion of the relationship of the various types of vegetative reproductive structures to one another.

Plant Pathology at Seale Hayne

THE fourteenth annual report from the Department of Plant Pathology, Seale Hayne Agricultural College, contains much useful and practical information. After a general survey of the pests that occurred during the year under review on the various agricultural and horticultural crops of the district, certain problems are treated in detail. Investigations have been made concerning the dwarfing disease of plants, especially polyanthus and cyclamen, from which it appears that the malformation is not necessarily associated with eelworm infestation, but that bacterial trouble may be the cause; the nature of the attack, however, is not yet understood. The hot-water treatment of narcissus bulbs for controlling eelworm is a further subject which has received much attention. Although satisfactory as a method for controlling the pest, damage to the flowers in the succeeding season has often occurred. The temperature of the water and the time of the year at which the treatment is carried are both exceedingly important. The period during which the bulbs are in a state of full dormancy is comparatively short, but it is the only safe time at which to carry out hot-water treatment. Varieties differ considerably as to the length of this safe period and their sensitivity to hot water, and the behaviour of many well-known varieties is described in detail for the guidance of the grower. The handling of the bulbs after treatment is also important, drying on trays being preferable to sacks. Further, the rate of cooling must not be too rapid, particularly in the case of bulbs treated early, or damage to the flowers will result. Dry planting appears to be preferable to planting in a wet condition, but if there is no storage accommodation, dipping the bulbs in a fungicide after the hot-water bath will reduce the likelihood of decay.

A Link Between Zygomycetes and Oomycetes

THE life-history of *Dicranophora fulva*, a fungus belonging to the Mucorales, has recently been studied by Dr. C. G. Dobbs (*Trans. Brit. Mycol. Soc.*, **21**, Pts. 3 and 4, 167; June 1938). This mould is of somewhat rare occurrence, but has several interesting features. It forms sporangia only when illuminated, and zygospores only in the dark. It has sexual reproduction by conjugation, but the male and female gametes are recognizable structurally. Contents of the male also migrate into the female gamete at fertilization; there is no equal fusion as usually happens in conjugation. The fungus is homothallic, and female gametes may, moreover, be formed without the stimulus of any opposite male. *D. fulva* is undoubtedly a member of the Zygomycetes, where conjugation is the rule; but it is also a link between that group and the Oomycetes, where a large sedentary egg is fertilized by small, motile male spermatozoa.

An Egyptian Mould Fungus

A MOULD fungus, *Penicillium egyptiacum*, isolated from soil in Egypt, is described in a recent paper by Younis S. Sabet (*Trans. Brit. Mycol. Soc.*, **21**, Pts. 3 and 4, 198; June 1938). The chief characteristic of this species appears to be that it forms ascigerous fruiting bodies with readiness upon most common media. Mycelium of the fungus is homothallic, and the perithecia appear under wide variations of temperature, relative acidity and atmospheric pressure, though humidity has a slight effect upon their formation. The species should provide very convenient material for teaching.

Soil Erosion in Tanganyika

AN interesting memorandum on soil erosion, by E. Harrison, director of agriculture, Tanganyika, has been issued by the Government of the Territory. A representative committee appointed to advise on the problem formed the opinion that the primary method of attack should be educative rather than ameliorative, and with this end in view the already existing authorities, such as forestry, veterinary and agricultural officers, were instructed to demonstrate

the serious nature of the loss caused by soil erosion, and to arouse interest in the methods by which it could be checked. In some districts the systems of land management evolved by the native cultivators were practically ideal counters to water erosion, but in others considerable time and patience will be required before the value of, and necessity for, adopting entirely new practices is realized. The relations between over-stocking and soil erosion are particularly intricate. The native husbandman is only capable of maintaining large numbers of cattle on land more or less denuded of persistent vegetation, as otherwise he incurs the ravages of ticks, flies and worms, and these are just the conditions which accelerate soil erosion. In view of this, the director of the veterinary services has outlined a scheme by means of which overstocking may be relieved. The chief items are: expansion of a rotational grazing system, increased water supplies and the control of the type and number of stock carried, and control of grass burning. Application of scientific knowledge coupled with some form of legislation is regarded as the best way of furthering the interests of the native. Anti-erosion rules have already been drawn up in a number of districts, with considerable success.

Structure of Pepsin

THE cyclol structure C_3 containing 288 amino-acid residues is proposed for the molecule of pepsin by D. M. Wrinch (*Phil. Mag.*, **24**, 940; 1937). In this structure the mid-points between adjacent atoms lie on the faces of a truncated tetrahedron which would account for the globular form of the molecule and the molecular weight of 39,200. The dimensions of unit cell in the crystal lattice, as determined by X-ray investigations, are $a = 67$ A., $c = 462$ A. Taking the density as 1·32, this gives a cell molecular weight of 1,434,000. Since half the weight of the crystals is made up of water removable at room temperature, then the number of molecules per unit cell must be $1{,}434{,}000/(2 \times 39{,}200) = 18{\cdot}3$. X-ray evidence has also suggested that the unit cell is a nine-layer structure, hence there must be two molecules to each layer, each of which is associated with (say) 2,350 water molecules. From the dimensions of the crystal cell, the size of the cyclol C_3 molecule and the possible arrangement of the 18 molecules in a nine-layer system in the cell, it is deduced that the molecules must lie some distance apart, the distance between parallel faces of adjacent molecules being sufficiently great to suggest co-ordination through the R groups of the molecules. Co-ordination of carboxyl groups (from the glutamic acid residues) with water molecules as intermediaries and of amide groups (from glutamine residues) are both suggested as possible. The great mass of the water molecules associated with the pepsin molecules in the crystal may form mega clusters between the layers of pepsin molecules resulting in a crystalline arrangement of atoms throughout the lattice. The presence of such clusters and of water molecules in the co-ordination bridges would imply a collapse of the structure if the water were withdrawn and would fit with the well-known fact that pepsin crystals lose their stability on drying.

Physical Investigation of Metallurgical Problems

A REVIEW dealing with the applications of magnetic determinations to the study of the structure of binary alloys of which one of the components is ferromagnetic has recently been published by W. Gerlach (*Naturwiss.*, **26**, 369; 1938). The problem particularly considered is that of precipitation hardening, that is, the hardness of crystals formed by deposition from a supersaturated solution of one metal in another. The author shows how a study of magnetization-temperature curves, and coercive force-temperature curves enables the phases to be analysed, illustrating this by the consideration of the curves for nickel-beryllium and nickel-gold alloys. The determination of the electrical resistance of alloys with and without the application of a magnetic field also yields results the same as those obtained by the former method. Investigations of the paramagnetism and diamagnetism of alloys may also be used, and Auer's work on the variation of susceptibility of a supersaturated mixed crystal system of copper and aluminium with time during which hardening is taking place at different temperatures is reviewed.

T Cassiopeiæ: a Temporary Reversal in its Curve

MR. F. M. HOLBORN has recently published a paper with this title (*J. Brit. Ast. Ass.*, **48**, 8; June 1938) in which he discusses small drops in the magnitude of this star while it is on the rise. Not only has Mr. Holborn recorded these drops; his observations have also been confirmed by others who have devoted much of their time to this subject, such as Prof. A. A. Nijland and Mr. N. F. H. Knight. Mr. W. M. Lindley, a well-known variable star observer, has added some remarks on Mr. Holborn's paper and agrees with him that long-period variables should be watched very closely for subsidiary phases and that observers should not hesitate to record such.

Ellipticity of Close Binary Stars

MR. J. LUYTEN has recently published a paper on this subject (*Mon. Not. Roy. Astro. Soc.*, **98**, 6; April 1938) in which he attempts to estimate the degree of central condensation in close binaries from their observed ellipticities. Three ellipsoidal variables are considered, ζ Andromedæ, b_1 Persei, and π_5 Orionis, the photo-electric light curves of which have been determined accurately by Stebbins and Huffer; spectroscopic orbital elements for the primaries have also been found. If ε represent the rotation effect and φ is the ratio of the centrifugal force to gravity at the equator of the primary, the values of ε/φ are found to be 45, 2·7 and 7·4, respectively, for the stars referred to. In the case of the average star, ε/φ might be expected to be about 0·6, and the discrepancy shows the difficulty of accepting light variation as due to ellipticity of figure. The paper deals also with those eclipsing binaries where estimates of the ellipticities have been made and in this case the position seems more hopeful. Stars of the W Ursæ Majoris and Beta Lyræ type, where the two components are almost equal in size and are revolving nearly in contact, have a mean value of 0·57 for ε/φ, indicating a central density condensation a little greater than that for the planet Saturn. Many of the Algol stars utilized in the work show that the mean value of ε/φ is 0·71, corresponding to a central density concentration intermediate between Saturn and Jupiter. As there are so many uncertainties involved in the computations it is impossible to say definitely what the real internal density concentration is. It may be some satisfaction to know that the results are not at variance with expectations; but beyond this it is impossible to go.

Research and the Amenities of Railway Travel

WE live in an age of rapid change, due largely to the increasing readiness and rapidity with which the results of scientific progress and research are applied to the conditions of life; and, in addressing the Institute of Transport on April 11, Sir Harold Hartley showed how the amenities of railway passenger travel are being improved. He confined his remarks to the aspect of the comfort of the passenger rather than to such desiderata as increased speed and safety. After indicating the several conditions which together determine the comfort of a railway journey at modern speeds, he proceeded to detail the steps being taken to ensure their maximum effectiveness.

Absence of vibration or irregular motion is probably the most important factor so far as the passenger's comfort is concerned, and although the difficulty of eliminating these increases greatly with increase of speed, much has been done in recent years to mitigate them. Smooth running depends on the design of rolling stock and railway track and on their maintenance, and was dealt with under three aspects: the motion of the wheel on the rail, the springing and coupling of the vehicles, and the effect of the permanent way. Over many years, a large number of experiments have been made with various designs of bogies and various conings of wheels in order to discover which type gives the best riding and the least wear, and standard practice has been based on the results.

More recently a complete theoretical and experimental investigation has been carried out in the Engineering Department of the University of Cambridge by Prof. C. E. Inglis and Dr. R. D. Davies, as a result of which the form of the sinuous path traversed by a pair of coned wheels and their axle has been determined. The results of their calculations were confirmed both in the laboratory and on the track and their theory suggests that, instead of coned wheels, cylindrical tyres should give complete immunity from lateral oscillations and 'bogie-hunting'. In agreement with this theory are the results of the cinematograph record taken by the Chicago, Milwaukee and North Shore Railway, which also showed that with the cylindrical wheel there was no regular oscillation and its flange rarely struck the rail. Experiments in the case of the L.M.S. train, *Coronation Scot*, with various conings and with cylindrical tyres proved the excellent riding qualities of the latter, and it was with these that the train was fitted when the record run from Euston to Crewe was made on November 16, 1936. Excessive flange wear, however, necessitated the trueing of the wheels after 20,000 miles service on the London–Glasgow run, and a compromise was then made of using a 1 in 100 coning, which gives almost as good riding at high speed without the disadvantage of excessive flange wear. Another method of avoiding oscillation is to mount the wheels so as to rotate independently. This eliminates 'bogie-hunting', there is no sliding motion on a curve and the riding of the coach is excellent, but the construction is much more complicated and the cost correspondingly high.

Coaches are also subject to oscillations due to impacts at rail joints and to other track irregularities. A combination of helical and laminated springs is used to damp out these; the former give elastic support while the latter damp out the vibrations. In addition, rubber is being used in seat and bed construction to eliminate vibration, the most effective material being rubber and metal or wood in alternate layers. Also associated with comfortable travel is the correct balance and centring of the coaches and the correct construction of the coupling and buffing gear holding the vehicles together and preventing surging and transverse oscillation. Accurate records of the riding qualities of different types of construction and of the deterioration due to wear are obtained by means of the Cambridge accelerometer which, by the movements of two weights held between stiff springs, prepares a graph of vertical and transverse oscillations and has thus helped greatly in effecting positive improvements.

The maintenance of the permanent way is an important factor in ensuring the comfort of the passenger. At high speeds, irregularities of the track lead to impacts which react so as to produce greater irregularity. Here, the Hallade recorder is used to give a continuous record on a strip of paper of the horizontal, vertical and rolling movements of the vehicle as it passes over the line and so shows where adjustment of the track is necessary. The Hallade method was used in improving the track for the accelerated timings of the *Coronation Scot* and, as a result, not only had the cant of rails to be readjusted to balance the centrifugal force but also the line had in places to be slewed to improve the alignment and transition curves had to be lengthened so that the train could take the curves smoothly and without rolling at high speed. On the rail joint problem, a mathematical and experimental research is being carried out at Cambridge, and its results are looked forward to with much interest, for each of these joints is a point of weakness in the track.

The reduction of noise is also receiving constant attention and is being effected, so far as possible, by eliminating its production, by absorbing it at its source, by avoiding its entry to the compartment, and by absorbing quickly such noise as does enter. Streamlining of coaches, welding of the track, the use of absorbent material for a top dressing on the track are some of the means in use. Heating and ventilation offer opportunities for the introduction of further amenities. The only satisfactory method of attaining steady conditions is by a closed system of air conditioning, but the weight and cost of the plant only justify its use in very hot and dry climates. Two proprietary systems of forced air ventilation are in use on main-line trains in Great Britain. Indirect lighting is coming into use and the crack train of the Victorian Railways—the "Spirit of Progress"—has indirect lighting for general purposes and shoulder lights for reading.

Of the improvements made in the æsthetic and general amenities the public is no doubt well aware. The more attractive external appearance of the trains, the materials and decorations used inside, the large windows, reduction of draughts, size and easy form of seats, all add to the enjoyment of the passenger, so that, in these unsettled hustling days, a long railway journey may be in some measure a comfortable relaxation and an escape from the disturbances of the world.

Clines: an Auxiliary Taxonomic Principle

By Dr. Julian Huxley, F.R.S., Zoological Society, Regent's Park, London

MODERN taxonomy, after a phase of 'splitting', adopted the integrating principle of geographical replacement, thus uniting numerous forms previously styled species as geographical races or subspecies of a polytypic species or *Formenkreis*[1]. It seems desirable, however, to go still further in the direction of synthesis. The naming and description of subspecific forms, however necessary, is not sufficient. Further, if not supplemented by some other method, it has two actual disadvantages—it focuses undue attention on named forms as against those which remain unnamed, even when the degree of distinctness is only slightly less in the latter; it also conveys a false impression of uniformity within the named group, and thus tends to inhibit the study of intra-group regularities of variation.

Some special term seems desirable to direct attention to variation within groups, and I propose the word *cline*, meaning a gradation in measurable characters. This, being technical, seems preferable to such a term as character-gradient or phrases such as 'geographical progression of characters', used by W. F. Reinig in his recent book "Elimination und Selektion". (Naturally, when it can be shown that such characters are non-genetic in origin, they will be valueless for taxonomic purposes.) Prefixes can be used to denote clines of different types, for example, ecocline, genocline (gradient in genes), geocline (geographical cline), chronocline (paleontological trend), etc. The term could be extended if desired, for example, ontocline for regular trends in individual development.

Clines may be of inter- or intra-group nature. Inter-group clines connect the mean values of the subspecies of a polytypic species (or of the species of a geographical subgenus or *Artenkreis*[1]). Numerous regularities of this sort are known, for example, the Rules of Bergmann, Gloger, Allen, etc. Rensch[1,2] has recently summarized the subject. Good examples affecting colour or size are found in many birds represented in Britain (wrens, puffins, spotted woodpeckers, bullfinches, tits, etc.). An illuminating case is that of the wrens inhabiting Fair Isle[3]. These are not sufficiently distinct to be given a separate subspecific name, but are intermediate in character as well as in position between *T. t. troglodytes* of the mainland and the Orkneys and *T. t. zetlandicus* of the Shetlands. To subsume these facts by a cline is to direct attention to a regularity that is concealed if we restrict ourselves to specification by the naming of areal groups.

Intra-group clines concern continuous variation within a population. Relatively little work has as yet been done on this laborious subject, for example, tongue-length in bees[4]; percentage of 'spectacled' forms in guillemots; fin-rays in fish[5]; pattern in lady-beetles[6]; vertebræ in fish[7]; temperature-resistance in *Drosophila*[8], etc. Sumner[9], in a coastal subspecies of deermouse (*Peromyscus*), has shown that the adaptively cryptic colour of the pelage changes gradually as one passes inland from white sand to dark soil. Still further inland there exists a distinct and much darker subspecies on very dark soil, which also shows a colour cline, though less pronounced. Where the two meet, there is a narrow zone about three miles wide where the mean colour changes very rapidly, and the variability is much higher. Off the coast, on an isolated island of white sand, lives a much paler subspecies. Here we have, first, an inter-group cline comprising three subspecies, and also intra group ones within the two inland groups. These run in the same direction as the inter-group cline, but are much less steep. These two geographical clines are separated by a very steep genetic cline (genocline) at the interbreeding zone.

In plants, ecological clines appear to be the commonest type. Gregor[10], in *Plantago maritima* has shown that each ecological habitat selects out a particular assemblage of genetic types, so that a regular ecocline will run from more to less saline surroundings. It is probable that similar ecoclines are to be found among land-snails (Rensch[1]).

It is in no way intended that specification by clines should replace any of the current taxonomic methods. It would constitute a supplementary method which, it is suggested, would correct certain defects inherent in that of naming areal groups, notably in stressing continuity and regularity of variation as against mere distinctness of groups. It is important to note that clines for different characters may run in different directions (shrikes[11], fox-sparrows[12], lincoln sparrows[13] etc.).

It would seem certain that, once attention is concentrated on this subject, regularities of intra-group variation will be found to be common—the rule rather than the exception. The correlation of these with environmental factors will undoubtedly often not be easy; and where the environmental factors vary in a complex way, the mere detection of regular phenoclines may be difficult, though not impossible[14]. However, if the study of such regularities is actively pursued, I would prophesy that we shall eventually gain a new picture of species. In many cases at least, the species will prove to consist of a population showing adaptive clines running in various directions: the continuous gradation will be broken up by various forms of isolation, which, by impeding interbreeding and the free flow of genes, will accentuate the mean adaptive differences between adjacent groups, as well as in some cases introducing non-adaptive differences[15]. The term cline is put forward as a step in this direction.

I have to make grateful acknowledgments to a number of systematists with whom I have discussed the subject, and who allow me to say that they believe that the use of the concept in taxonomy would be useful, notably Mr. M. A. C. Hinton, Mr. N. D. Riley and Mr. J. R. Norman of the British Museum (Natural History), Mr. J. S. L. Gilmour and Dr. W. B. Turrill of the Royal Botanic Gardens, Kew, Mr. B. W. Tucker of Oxford, the Rev. F. C. R. Jourdain, and

the Committee on Comparative Systematics of the Association for the Study of Systematics. I have also to thank Dr. J. Ramsbottom for suggesting *cline* as the best term to denote gradation.

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[15] Wright, Sewall, *Genetics*, **16**, 97 (1931).

The Geological History of Northern Central Africa

UNTIL quite recently, the interior of that vast tract of Africa which lies north of the equator and west of the Nile was virtually *terra incognita* to the geologist. During the last few years, however, geologists of several nationalities, particularly French and Belgian, have been actively engaged in the survey of various portions of this area. As a result, a considerable amount of information on the geology of the region has become available, but is scattered among numerous publications many of which are not easily accessible to British students. The literature is, moreover, somewhat bewildering owing to the numerous unfamiliar stratigraphical terms which have been introduced.

A well condensed and useful synthesis of existing information on this subject has recently been published by Dr. K. S. Sandford (*Quart. J. Geol. Soc.*, **93**, 534; 1937), who was attached to Major R. A. Bagnold's expedition in 1932 for the survey of the north-western frontier of the Anglo-Egyptian Sudan, and so has been able to approach the subject from the point of view of one whose own field-work has taken him into almost the very centre of the area.

In the geological history of this area as a whole continental conditions have prevailed over long intervals of time, but three main periods are recognizable when considerable transgressions of the sea took place. An Archæan basement complex of highly metamorphosed rocks is covered discordantly in most districts by pre-Cambrian sediments, probably largely of marine origin. Still in pre-Cambrian times, these rocks were subjected to intense folding and considerably metamorphosed by pressure which came mainly from the east and west. In many districts these movements were accompanied by igneous intrusion. These ancient rocks, which are exposed over large areas at the present day, form the foundation of the African continent.

The Lower Palæozoic was a period of marine transgression; no Cambrian rocks have been discovered anywhere in the area, but it is probable that in the Ordovician and Silurian the sea covered most of Africa north of the equator and west of the present continental watershed. The occurrence of graptolites, brachiopods, calcareous algæ, and other organisms at a number of localities enables the beds to be dated with some degree of accuracy. South of the great ridge joining Abyssinia to the Gulf of Guinea, however, the rocks of the Katanga System, which are at least in part marine, have yielded no fossils except obscure algal remains. The dating of these rocks is, therefore, still largely a matter for dispute. As shown by Dr. Sandford, most workers favour the reference of at least the upper part of the succession (the Kundelungu Series) to the Palæozoic. The possibility of a pre-Cambrian age for the whole system cannot, however, be considered to be definitely excluded. Glacial tillites, absent from the Palæozoic of the more northerly region, occur here at more than one horizon.

Caledonian movements were mainly limited to simple elevation, so that the Palæozoic strata, in general, have remained unfolded. In the central Sahara, however, broad Caledonian folds have affected the Devonian beds, while in the south the beds of the Katanga System are involved in severe folding which may have occurred in Devonian times. These movements resulted in the progressive exclusion of the sea in later Palæozoic times, thus inaugurating a period in which the interior of Africa was once more a vast continental region undergoing denudation.

To this period belong the deposits of the Karroo System—the Lualaba and Lubilash beds of Belgian geologists—which cover wide areas in the Belgian Congo. Unlike the contemporaneous beds of South and East Africa, these are poor in fossils. To the north and north-east, the Karroo deposits pass laterally into beds classed as "Nubian Sandstone". Further information is desirable about certain beds near Guider (Léré), in the Cameroons, where brachiopods (afterwards lost) are reported to have been found by O. Mann associated with fish remains described by E. Hennig as *Lepidotus manni*. A Jurassic age has been suggested for these beds, but there is no other evidence of a marine invasion of the area in Jurassic times.

In Cretaceous times, a renewed transgression of the sea took place, more restricted than that of the Palæozoic, but resulting, apparently, in a temporary connexion between the Tethys and what is now the Gulf of Guinea. In the Eocene, the sea appears to have covered much the same area as in the Upper Cretaceous, although there is usually a discordance between the beds of the two periods. Except marginally and very locally the sea has been excluded from the whole area in post-Eocene times. Alpine orogenic movements affected only the northern marginal belt of the Continent, but in the interior differential movements gave rise to a series of lake basins the deposits of which, sometimes silicified, are now being recognized. The Upper Tertiary was a period of much volcanic activity, which has persisted almost to Recent times.

The long list of recent publications which accompanies Dr. Sandford's paper should prove most useful to those seeking further information on the area.

The Control of Water Supplies

THE first report of the Central Advisory Water Committee, just issued from the Ministry of Health (H.M. Stationery Office, 6*d*. net), summarizes the conclusions arrived at by the Committee on a number of suggestions submitted to it for new legislation to facilitate the conservation and supply of water and the co-ordination of water interests. The most urgent of these questions, in the Committee's opinion, were proposals for (*a*) the control and conservation of needed underground water resources and the protection of underground water from pollution; (*b*) the planning of water resources and supplies; and (*c*) the modernization of the existing law relating to the supply of water by local authorities and water companies.

With regard to the first matter, the approved findings of a special underground water sub-committee are given in which it is recommended that control should be exercised only in defined areas in which the conservation of underground water is shown, after investigation, including public inquiry, to be necessary in the public interest, with the further recommendation that the Minister of Health should be empowered, either on his own initiative, or on the application of any interested regional advisory water committee or person, and after consultation with the Central Advisory Water Committee, to make orders defining areas in which control of the abstraction of underground water is necessary in the public interest. These, with certain other recommendations relating to waste and pollution of supplies, it is noted, will entail substantial amendment of the existing law, under which owners have the unrestricted right to abstract water from under their land, or to allow underground resources which they have tapped to run to waste; they affect also, to some extent, the powers of owners to dispose of waste matters which may cause pollution. The Committee is satisfied, however, as to the necessity and value of the suggested provisions.

The second of the questions under consideration, namely, the planning of water resources and supplies, forms the subject of another special report by a sub-committee, in which it is pointed out that the regional planning of public water supplies by joint committees of water undertakers is of comparatively recent origin. There are now nine regional committees in existence, comprising areas with a total population of some fifteen millions. Although the central committee is satisfied as to the need for regional planning by regional committees, it considers the existing procedure should be amended and that in place of voluntary assistance in their researches, the regional committees should be empowered by statute to make precepts on constituent authorities for their expenses and to obtain necessary information of consumption and resources. The Minister of Health should, in the Committee's opinion, be empowered to require all persons abstracting water to furnish returns of any water abstracted and not returned to the stream from which it was taken, an exception being made in favour of private individuals who abstract water for their own domestic use. With certain reservations in regard to details, these returns should be made public to the extent of affording information in the aggregate of the quantity of water abstracted in suitable areas.

The reconstitution of the regional committees is advocated in order to obtain greater efficiency, a limit of 10 members in each being considered desirable, inclusive of an independent chairman. The lack of contact between water undertakers and other interests is met by the recommendation that it should be obligatory for the committees to consult all interested bodies, including catchment boards, fishery boards, harbour and navigation authorities and industrial users, before definite proposals are formulated in which the interests of these bodies are likely to be affected. Other recommendations are made for increasing the powers of the Minister of Health in regard to the formation or alteration of joint boards and the amalgamation and acquisition of water undertakings. As regards the modernization of the law relating to water supply, it is stated a consolidation bill is in course of being drafted for submission to the Minister of Health.

B. C.

The Museums Association

Annual Conference at Belfast

THE forty-ninth Annual Conference of the Museums Association was held in Belfast in the week commencing July 4, and was attended by representatives of museums of all parts of Great Britain and by a number of delegates from overseas. The president, Dr. R. E. Mortimer Wheeler, announced that Her Majesty Queen Mary had graciously consented to become the patroness of the Association.

In his presidential address, Dr. Wheeler dealt with a number of current museum problems, and referred especially to the need for folk parks in England, and for the preservation, either there or elsewhere, of historic horse-drawn vehicles which have now become obsolete.

A large part of Dr. Wheeler's address was concerned with air raid precautions in museums and art galleries. The Museums Association has held a meeting on this subject, and has approached the Standing Commission on National Museums for advice. Museum buildings may be reinforced, deep basements or country house storage may be provided for objects of primary importance, and a plan prepared for immediate action in case of emergency. Any person, Dr. Wheeler said, who is directly or

indirectly responsible for a museum or art gallery is neglecting an essential part of his duty if he is not taking all feasible steps to protect his collections from possible war risks.

A discussion on museums and field archæology, opened by Sir Cyril Fox, director of the National Museum of Wales, led to a general agreement that field work is a most important part of the training of museum officials who are in charge of archæological material. Not only does it enrich the museum, but it also provides officials with personal contacts, and a background of knowledge that is invaluable in the study of their own collections. Curators should be given facilities to take part in excavations as an official part of their museum work. In the same discussion, Mr. Christopher Hawkes of the British Museum directed attention to the need for a national archæological survey with centralized records.

"Youth in Museums" was a subject of three papers by Miss Mary S. Shaw, Miss C. Mirèio Legge and Miss Bertha Hindshaw, all of Manchester, who, from the point of view of an Egyptologist, a zoologist and the curator of a children's museum, discussed the way in which museum collections could be used for vivid educational work.

Mr. Trevor Thomas, of the Liverpool Public Museums, read an original and stimulating paper on the æsthetics and technique of museum display—a subject which is, perhaps, of little obvious concern to the scientific worker, but which is, nevertheless, of the very greatest importance if museum exhibits are to appeal to the visitor, whose attention is arrested by vigorous display, in which the objects are grouped and arranged in an attractive manner. In this connexion, the results of experimental psychology should not be neglected.

Mr. Frank Pick, of the London Passenger Transport Board, gave a vigorous address on the form and purpose of a local museum, which was illustrated by many comparisons between museums in Britain and those in other countries. The primary question is, he said, to whom or to what is a museum directed? It is necessary for every museum to work to a specific aim and purpose, and specialized museums are needed; for example, Britain has no museum giving a synopsis of the history and development of agriculture, nor is there one dealing with the history, meaning and purpose of clothes. A museum can justify itself only as it establishes relationships with current life, and its administration is work requiring great imaginative activity.

Among other papers at the Conference, Mr. E. Rimbault Dibdin discussed the question "Are Art Galleries Obsolete?"; Mr. J. H. Hewitt talked of the place of reproductions in the gallery; Mr. A. F. Reeve Fowkes made a plea for a circulating national gallery, and Mr. J. A. S. Stendall described museum methods in Scandinavia. A film on the work of the Royal Scottish Museum was presented by its director, Mr. T. Rowatt.

Mr. S. F. Markham, discussing the future of the museum movement in Britain, made an informative and practical contribution. His views will no doubt be found expressed in detail in the report on this subject which he is preparing for the Carnegie United Kingdom Trustees.

About two hundred and thirty delegates attended the Conference, and were entertained by the Lord Mayor of Belfast, by the Belfast Museum Committee, and by Queen's University. There were excursions to the Giant's Causeway, to Armagh, and to archæological sites in Northern Ireland.

Next year's Conference will be held at Cheltenham in the week commencing July 3; it will be the jubilee of the Museums Association, and will be under the presidency of Viscount Bledisloe.

International Physiological Congresses

THE sixteenth International Physiological Congress, which will be held in Zurich on August 14–19, may be considered to mark the fiftieth anniversary of the first congress, which was held in the same country. In honour of the occasion, F. J. Franklin has written a fascinating history of these congresses, which is published in *Annals of Science* (3, Part 3). It is illustrated with thirty-five photographs of presidents of the congresses and others who have contributed to their success. Copies are to be presented to all members.

Dr. Franklin gives a large number of details of the organization of these congresses which will be very useful to those responsible for congresses in the future, but he has done far more than this. He has managed to catch and convey something of the enthusiastic spirit which animated the early congresses, when about a hundred keen workers met together to demonstrate experiments to one another. Every effort was made to keep the arrangements as simple as possible, and particular stress was laid on the importance of demonstrations. There was at one time a movement in favour of abolishing other forms of communication altogether, but this was thought to be impracticable.

The first congress was the result of a letter sent by the Physiological Society, London, to 109 physiologists in 1888. It met the next year in Basle, and Dr. Franklin quotes interesting reminiscences of several of the eleven survivors. This congress was so successful that it was decided to hold similar congresses every three years, and they met successively at Liége, Bern, Cambridge, Turin, Brussels, Heidelberg, Vienna and Groningen (1913). Speeches were made which emphasized the international spirit of science, and it is sad to remember how this spirit was forgotten in the years of the Great War. The congress in Paris in 1920 was confined to physiologists from allied countries, and the next truly international congress was held in Edinburgh three years later. Since then congresses have been held in Stockholm, Boston, Rome and Leningrad. The membership has grown to about 1,500 and the scientific demonstrations have tended to be overshadowed by the banquets, concerts and sight-seeing expeditions which have been generously provided by the Governments of some of the countries which have acted as hosts.

An attempt is being made this year to return to the simplicity of the early congresses. Membership

is limited to genuine physiologists and their families, and the social entertainments will be less elaborate, but physiology itself cannot be made simple again. The number of communications is large, and it is still necessary to hold meetings simultaneously in five lecture rooms.

The Swiss organizing committee is introducing important innovations. Fifteen discussions have been organized on the kidney, the regulation of the circulation, the chemical transmission of nervous impulses, oxidation, the permeability of the skin, electro-physiology, steroids, fœtal respiration, nutrition, the control of respiration, the adrenal cortex, the anterior pituitary, the analysis of speech, the potential action of drugs and vitamin B_2. The contributions of the two openers of each of these discussions have already been circulated with the general programme of the meeting. The opportunity to study such documents in advance is a great boon, but it has only been granted once before. There is every reason to hope that this congress will be remembered for the high value of its scientific meetings.

J. H. GADDUM.

Beit Memorial Fellowships for Medical Research

AT a meeting of the trustees of the Beit Memorial Fellowships for Medical Research held on July 13, it was reported that F. R. Winton (fellow, 1927–31) had been appointed to the professorship in pharmacology in the University of London, held at University College; G. R. Cameron (fellow, 1930–33) to the professorship of morbid anatomy in the University of London, held at University College Hospital Medical School; A. R. Todd (fellow, 1935–36) to the professorship of chemistry in the University of Manchester; and that R. J. Kellar (fellow, 1935–37) had been appointed reader in obstetrics and gynæcology, University of London, at the British Postgraduate Medical School, London.

The total number of fellowships held by full-time workers during the year 1937–38 was 23. The number of candidates at the present election was higher than usual; five applied from Canada and three from Australia. Fortunately, reserve funds made it possible to award more junior fellowships than are ordinarily given each year, and the election of twelve new junior fellows brought the total of those elected since the beginning of the Trust in 1910 to be exactly 200. A fresh edition has been printed this year of the "Green Book" which summarizes briefly the after-careers of fellows and their present position in research.

The following elections were made, the subject and place of research being given after each name:

Senior Fellowship (value £700 a year): Dr. D. E. Green, to continue research on the role of vitamin B_1 in the oxidation of pyruvic acid, and to study a new flavin-protein compound in milk (Institute of Biochemistry, University of Cambridge).

Fourth Year Fellowship (value £500 a year): Dr. M. H. Salaman, to continue research on vaccinia and animal pox viruses (Lister Institute of Preventive Medicine, London).

Junior Fellowships (normal value £400 a year): Dr. G. Bourne, director of the Department of Experimental Biology, Australian Institute of Anatomy, Canberra, 1935–36 and biochemist, Commonwealth Advisory Council on Nutrition, 1937—significance of vitamin C in the endocrine system (Department of Human Anatomy, University of Oxford); Dr. A. L. Chute, of Toronto General Hospital—experimental studies in metabolism of the brain (Department of Physiology, University College, London); Dr. R. O. L. Curry—physiology of speech disorders by photographic study of laryngeal movements (University College, London); Dr. J. F. Danielli, demonstrator in biochemistry and biophysics, University College, London—permeability of normal and denervated muscle to metabolic products and to drugs (Institute of Biochemistry, University of Cambridge); Dr. J. G. Dewan, assistant physician, Toronto Psychiatric Hospital, 1933–35, and since 1936 research worker at the Institute of Biochemistry, Cambridge—'insulin shock' treatment of schizophrenia by experimental studies of brain metabolism (Institute of Biochemistry, University of Cambridge); Dr. Catherine O. Hebb, since 1937 research assistant, Department of Physiology, McGill University—effect of thoracic sympathectomy on the activities of the lung (Department of Physiology, University of Edinburgh); Dr. B. Katz, since 1935 research worker in biophysics, University College, London—electric excitation and transmission of impulses in nerve and muscle of animals (Department of Biophysics, University College, London); J. H. Kellgren, resident appointment, University College Hospital, London, 1935–36, and since 1937 research worker in its Department of Clinical Research—painful conditions of the limbs and back (Department of Clinical Research, University College Hospital, University of London; Dr. J. J. D. King, house surgeon, Dundee Dental Hospital 1931–32, since 1936 research grantee of Medical Research Council—dental caries and parodontal disease (Medical School, University of Sheffield); Dr. H. Lehmann, research worker, Physiological Institute, Heidelberg, 1934–36, since 1936 research student of Christ's College, Cambridge—blood sugar in animals, and iron metabolism in plants (Institute of Biochemistry, University of Cambridge); W. J. O'Connor, resident medical officer, Adelaide Hospital, 1936, lecturer in human physiology and pharmacology, University of Adelaide, 1936–37—effect of strophanthin on the oxygen consumption of the heart (Laboratory of Pharmacology, University of Cambridge); H. Scarborough, house physician, Royal Infirmary, Edinburgh, since 1934 assistant in Department of Therapeutics, University of Edinburgh—mode of destruction of vitamin C in the human body (Clinical and Chemical Laboratories, Royal Infirmary, Edinburgh).

All correspondence of fellows and candidates should be addressed to Prof. T. R. Elliott, honorary secretary, Beit Memorial Fellowships, University College Hospital Medical School, University Street, London, W.C.1.

Science News a Century Ago

Faraday and Schönbein

ON July 30, 1838, Faraday wrote to Schönbein: "My dear Sir. You know how I value your letters and may conclude that the last was very pleasant to me; though there is always a feeling of deep regret that the treasures which accompany your communications being in the German language are sealed up to me. . . . You mention Fechner's objections to my theory [of the voltaic pile] and I am exceedingly anxious to see and consider them but do not know whether they are acceptable to me or not. . . . I am very anxious to know of all important objections but I do not mind about slight ones. Many have been made to me which been left to themselves have disappeared in a few months from the minds of the objectors themselves; but good and valid objections are of great importance and often I think prove the key to new discoveries. . . . Dr. Poggendorff who was here lately told me of Fechner's objections but when he learnt from me that I by no means go the length of De la Rive and that I admit *many other modes of electrical excitement* besides chemical action, I thought he seemed to think that Fechner's objections were rather against De la Rive than me. . . ."

Fossils of Great Britain

ON August 2, 1838, under the title "Fossil Remains", *The Times* printed a petition which had been addressed to the Chancellor of the Exchequer relating to the decision not to purchase for the British Museum "the two valuable collections, illustrating the geology of an important portion of England" formed by Mr. Mansell and Mr. Hawkins. The petitioners stated that the collections were of peculiar value as demonstrating the subterranean structure of Great Britain, that it would be conducive to the honour and scientific reputation of England if they were placed in the British Museum, that their formation had resulted from a concurrence of rare opportunities, and extraordinary qualifications in the individuals who had made them, and that if the collections were not then secured for the nation the chance of doing so might be lost for ever. There were eighteen signatures to the petition, among them being those of Buckland, Sedgwick, Owen, Murchison and Darwin.

Opening of the Polytechnic Institution

ON August 2, 1838, the Polytechnic Institution, 309 Regent Street, London, was opened for a private view by supporters of science, and four days later it was thrown open to the public, a shilling being charged for admission. The extensive building had been erected to provide reading and lecture rooms and demonstration galleries for illustrating the principles upon which every science was based, and the processes employed in arts and manufactures. When ready for opening, it contained a printing press, an optician's workshop, a rotatory steam engine, power looms, a diving bell, a model canal and docks, electrical and astronomical instruments, etc.

Owing to financial losses the Institution was closed in 1859, but in the following year it was reopened by a new company. In 1872 the classes were formed into a college which was inaugurated by the Earl of Shaftesbury. In 1882 it was purchased by Quintin Hogg and opened as the Polytechnic Young Men's Christian Institute.

University Events

EDINBURGH.—The laureation and graduation ceremony on July 20 was also the occasion of the installation of the chancellor, Lord Tweedsmuir, Governor-General of Canada, who had been elected by the graduates to succeed the late Sir James Barrie. After conferring the honorary and ordinary degrees, mainly in medicine and law, the chancellor delivered his address in which he discussed the functions of a university under modern conditions. In the course of this he stated: "The instruction of a University must be in the general principles, the fundamental propositions, the theory, of any discipline. It cannot profess to teach the practice of a profession, for it cannot keep step with its rapid changes. . . . So one should regard as a primary function of a university the trusteeship of humane learning, the guardianship of the central culture of mankind. Its task is to pursue truth by research, by experiment, and by speculation and in so doing to inspire its members, young and old, with the love of truth, which includes the love of beauty, and with that spirit of disinterested inquiry which means intellectual freedom."

Among others, the honorary degree of doctor of laws was conferred on the Right Hon. Sir John Anderson, M.P. for the Scottish Universities; the Right Hon. Walter Elliot Elliot, Minister of Health; Sir Alexander Gibb; the Right Hon. William Shepherd Morrison, Minister of Agriculture and Fisheries; the Right Hon. Lord Eustace Percy, rector of King's College, Newcastle, and pro-vice-chancellor, University of Durham.

The degree of D.Sc. was conferred on A. D. Buchanan Smith for the thesis "Studies on the Inheritance of Yield and Quality of Milk in Dairy Cattle".

For the first time, the University awarded the degree of B.Sc. with honours in pharmacology which was gained with first-class standing by the Earl of Suffolk and Berkshire.

LONDON.—The following titles have been conferred in respect of posts held at the schools of the University indicated: professor of anatomy, Mr. E. P. Stibbe (King's College); reader in clinical pathology, Dr. Montague Maizels (University College Hospital Medical School); reader in demography, Dr. R. R. Kuczynski (London School of Economics); emeritus professor of electrical engineering, Prof. J. T. MacGregor-Morris, on his retirement from the University professorship of electrical engineering at Queen Mary College; emeritus professor of organic chemistry, Prof. J. F. Thorpe, on his retirement from the University professorship of organic chemistry at the Imperial College—Royal College of Science; emeritus professor of physical chemistry, Prof. J. C. Philip, on his retirement from the University professorship of physical chemistry at the Imperial College—Royal College of Science.

The degree of D.Sc. (engineering) has been conferred on: Mr. A. G. Pugsley (Battersea Polytechnic) and Mr. J. E. P. L. Vigoureux (Imperial College—City and Guilds College).

SHEFFIELD.—The following appointments have been made: J. R. Grimoldby, to be demonstrator in anatomy; G. E. Cooke, to be assistant lecturer in civil engineering.

Dr. J. E. Smith, lecturer in zoology, has resigned.

Societies and Academies

Dublin

Royal Irish Academy, June 27.

WINIFRED E. FROST: River Liffey survey (2). The food of the brown trout (*Salmo trutta*, Linn.) from acid and alkaline waters. Brown trout from acid waters are usually small and slow-growing compared with those from alkaline waters. Two stations were selected on the River Liffey, one Ballysmuttan acid water, the other, Straffan, alkaline water. Stomach contents of 349 brown trout from Ballysmuttan and 228 from Straffan were examined. Seasonal nature of the food consumed is described. Quality and quantity of different food organisms eaten are compared. Some comparison of food available at the two stations is given. It seems possible that the amount of food available is not responsible for difference in growth-rate and size of Ballysmuttan and Straffan trout.

Paris

Academy of Sciences, May 30 (*C.R.*, 206, 1601–1688).

ALEXANDRE GUILLIERMOND and ROGER GAUTHERET: Culture of plants in media containing colouring matters. The degree of toxicity of the colouring matters. A table of results with twenty-seven dyes is given showing the toxic effects on wheat seedlings: neutral red is the least toxic, while at the other end of the scale come malachite green and aurantia.

ANDRÉ BLONDEL: The influence of the definition of magnetic losses on the properties of the circular diagram of induction motors.

KENTARO YANO: The projective space of D. van Dantzig.

ALEXANDRE FRODA: Topological properties of functions of real variables.

BERNARD SALOMON: Dynamic reductors of oscillations particularly applicable to machine shafts.

GÉRARD DELANGHE: On certain general properties of balancing piston machines, according to the method of symmetrical rotating vectors.

HENRI MINEUR: The gravitation potential of the galaxy.

EMILE SEVIN: The problem of thermal agitation in the presence of a field of gravitation.

PIERRE MONTAGNE: The use of ammonia as a fuel in explosion motors.

MLLE. SUZANNE VEIL: Silver and platinum and silver and nickel in aqueous potassium iodide and their electrostatic aspect.

MME. NIUTA WINTER-KLEIN: The influence of strains on the variation of the refractive index of glass.

PAUL GESTEAU: Method for the qualitative and quantitative study of sources of radiations and of photographic emulsions in the field of the ultra-violet.

MAURICE BILLY and ALAIN BERTON: Absorption spectra by reflection of solid substances in the visible and ultra-violet regions. Absorption spectra by reflection can be used to supplement other methods of investigation of solid bodies, such as diffraction spectra and the X-rays.

PIERRE MESNAGE: The band spectra of the iodides of the alkaline earths.

PIERRE JACQUINOT: The Zeeman effect of an abnormal argon series.

MME. ARLETTE VASSY: The absorption coefficients of ozone in the region of the Chappuis bands.

RENÉ AUDUBERT and J. MATTLER: The action of gases on the photogenic reactions accompanying the thermolysis of sodium azide.

ANDRÉ GUINIER: A new type of X-ray diagrams.

MME. IRÈNE CURIE and PAUL SAVITCH: The nature of the radio-element of 3·5 hours period formed in uranium irradiated by neutrons.

MME. S. COTELLE and MOÏSE HAÏSSINSKY: The preparation of thin layers of thorium and of actinium by electrolysis in ethyl alcohol.

RENÉ DELAPLACE: The thermal conductivity of gaseous hydrocarbons and the atomic polarization.

GUSTAVE RIBAUD and HUBERT GAUDRY: The influence of the value of the pressure on the velocity of propagation of flame under constant pressure, in uniform régime, in mixtures of air with propane and with coal gas.

MME. NATHALIE DEMASSIEUX and BASILE FEDEROFF: The dehydration of the double sulphate of nickel and potassium.

MME. RAYMONDE DUVAL: The stereoisomerism of the cobaltitrinitrotriammines.

ARMAND GROSS: Explosive decomposition with the acetylene flame.

MME. RAMART-LUCAS: The structure and absorption of the triphenylmethane amino colouring matters.

MME. YVONNE KHOUVINE and GEORGES ARRAGON: The nitric oxidation of the methyl derivatives of sorbose.

CHARLES PRÉVOST and OU KIUN HOUO: A decomposition of the primary and secondary β-ethylenic alcohols.

LOUIS MARGAILLAN and XAVIER ANGELI: The passage from stearic acid to oleic acid by catalytic dehydrogenation. Methyl stearate carried as vapour in a current of ethylene over reduced nickel at 220°C. is partly reduced to methyl oleate.

ERNEST CHAPUT: The Permian and the Eocene in the south-west of the interior of Anatolia.

SOUBHI NAZLOUM: The analysis of the components of Afrine at Midanki.

LOUIS GLANGEAUD: A method of studying the mud in suspension in estuaries and rivers.

RENÉ BERNARD: The formation of free atoms of sodium in the upper atmosphere.

MLLE. ALINE DUSSEAU: First cultures of fungi on 'Cellophane'.

EMILE MICHEL-DURAND: The principles of pollen containing phosphorus.

JOSEPH LEFÈVRE: The normal presence of indolic acids and especially of 3-indol-acetic acid in various higher plants.

JACQUES LUCIEN MONOD and MLLE. YVETTE NEEFS: The extraction and estimation of the eye pigment of *Drosophila*.

MAURICE FONTAINE and RENÉ GUY BUSNEL: The distribution of flavine and of substances with a blue fluorescence in the skin and scales of fresh-water fishes.

ALBERT PEYRON: The presence of primordial genital cells in the embryonic buds of parthenogenetic embryomes in man.

PHILIPPE L'HÉRITIER and GEORGES TEISSIER: The hereditary transmission of sensibility to carbon dioxide in *Drosophilia*.

MARIUS PIÉRY, JEAN ENSELME and MLLE. SIMONE PETEL: Researches concerning the subject of the influence of mineral waters on tissue respiration. Function of potassium ions and of ferric ions. The action of a ferruginous mineral water.

JEAN CUILLÉ and PAUL LOUIS CHELLE: Is *tremblante* of the sheep determined by a filtrable virus?

Moscow

(*C.R.*, 19, No. 1–2, 1938).

N. SMIRNOFF: Application of the Fourier integral to the integral non-linear equations.

A. CHEPELEWSKIJ: The stochastic scheme of Pearson's equation.

L. KELDYCH: The grids defining measurable entities *B*.

N. W. ADAMOFF: Investigation of periodic solutions of an ordinary differential equation of the first degree by the method of successive approximations.

N. LUSIN: Existence of algebraic surfaces without continuous network.

I. I. PRIVALOV: The principle of maximum generalized for subharmonic functions.

N. REIN: (1) Development of the method for the evaluation of the period of solution of a restricted problem of three bodies. (2) A simplified scheme of an elliptical restricted problem of three bodies.

K. OGORODNIKOFF: Theoretical analysis of the Wolff's method of star counts in dark regions.

A. B. SEVERNY: The Compton scattering of radiation within a star.

L. GROŠEV and I. M. FRANK: Angular distribution of pairs in krypton.

S. RODIONOV, E. PAVLOVA and N. STOOPNIKOV: A new anomalous effect in the short-wave end of the solar spectrum (1).

S. RODIONOV and E. PAVLOVA: Contribution to the problem of the Umkehr-effect (2).

A. A. NOVITSKIJ: Researches on the periperic visual adaptations during twenty-four hours.

N. AGEEV: Unlimited solubility of metals in the solid state.

B. A. PETRUSHEVSKY: The domes of the region near the Dzhezkazgan.

D. S. BELIANKIN, V. P. PETROV and R. P. PETROV: First nepheline syenite in Transcaucasia.

A. S. SEREBROWSKY: Genes Scute and Achaete in *Drosophila melanogaster* and a hypothesis of gene divergency.

E. D. LEVINA: A chemico-genetic study of the plum.

A. N. LUTKOV: Tetraploidy in *Linum* induced by high-temperature treatment of the zygote.

J. M. KABAK: Antigonadotropic serum.

F. P. MAZANKO: (1) A new method of tau-saghyz exploitation. (2) Rubber formation in tau-saghyz.

T. J. ZARUBAILO: Response of unripened wheat grain to yarovization effect of chilling.

M. CH. ČAYLACHJAN and L. P. ŽDANOVA: Hormones of growth in formation processes. (1) Photoperiodism and production of growth hormones.

I. D. ROMANOV: A new form of the embryo sac of the *Adoxa* type in *Tulipa tetraphylla* and *T. ostrovskiana*.

M. I. KNIAGINICHEV and T. M. GORELKINA: Structural peculiarities of starch in the cereal and the leguminous seeds.

K. A. BRODSKY: Contribution to the ecology and morphology of *Calanus tonsus* Brady (*Calanus plumchrus* Marukawa) of far-Eastern seas.

N. V. NASSONOV: Morphogenesis following the insertion of parts of various organs under the skin of the axolotl. (1) Lung as organizer. (2) Small intestine as organizer. (3) Gills as organizer.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PROFESSOR OF ARCHÆOLOGY in the University of Malta (to act also as secretary of the British Institute at Malta)—The British Council, 32 Chesham Place, London, S.W.1 (August 6).

ASSISTANT at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (August 6).

COUNTY INSTRUCTOR IN POULTRY KEEPING in the Kirton Agricultural Institute, Boston, Lincs.—The Principal (August 10).

LECTURER IN MATHEMATICS in the University of Reading—The Registrar (August 19).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Bradford Technical College—The Principal (August 20).

PRINCIPAL OF HENDON TECHNICAL COLLEGE—The Secretary of the Education Committee, Education Offices, 10 Great George Street, Westminster, S.W.1 (August 27).

HEAD OF THE MARINE ENGINEERING DEPARTMENT, University College, Southampton—The Registrar (August 31).

BIOCHEMIST in King's College Hospital, Denmark Hill, London, S.E.5—The House Governor (September 1).

PROFESSOR OF INORGANIC AND PHYSICAL CHEMISTRY in the Egyptian University, Abbassia, Cairo—The Dean of the Faculty of Science (September 15).

DIRECTOR OF THE INDIAN INSTITUTE OF SCIENCE, Bangalore, India—The Registrar (September 15).

SENIOR LECTURER IN ECONOMICS in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for South Africa, South Africa House, Trafalgar Square, London, W.C.2 (October 1).

LECTURER IN FORESTRY in the University of Aberdeen—The Secretary (October 31).

PHYSICISTS at the Shirley Institute (British Cotton Industry Research Association), Didsbury, Manchester—The Director of Research.

LECTURER IN CHEMICAL ENGINEERING in the University of Sydney—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

LECTURER IN GEOGRAPHY in Raffles College, Singapore—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 5: Subaqueous Transpiration. By Prof. H. H. Dixon. Pp. 55–58. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 6*d*. [187

Permanent Consultative Committee on Official Statistics. Guide to Current Official Statistics of the United Kingdom. Vol. 16 (1937): Being a Systematic Survey of the Statistics appearing in all Official Publications issued in 1937. Pp. 406. (London: H.M. Stationery Office.) 1*s*. net. [187

North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1938. Pp. xii+64. (Aberdeen: North of Scotland College of Agriculture.) [187

Other Countries

Report of the Twenty-third Meeting of the Australian and New Zealand Association for the Advancement of Science, Auckland Meeting, January 1937. Edited by F. J. A. Brogan. Pp. xlv+500+17 plates. (Sydney, N.S.W.: Australian and New Zealand Association for the Advancement of Science.) [147

American Philosophical Society. Year Book 1937. Pp. 433. (Philadelphia, Pa.: American Philosophical Society.) [187

Proceedings of the Second Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry, held at Madras from the 14th to the 16th December 1936; with Appendices. Pp. v+284. (Delhi: Manager of Publications.) 3.10 rupees; 6*s*. 3*d*. [187

Further Zoological Results of the Swedish Antarctic Expedition 1901–1903 under the direction of Dr. Otto Nordenskjöld. Edited by Sixten Bock. Vol. 3, No. 4: Ascidiacea, Part 1. By A. Arnbäck-Christie-Lund. Pp. 54+4 plates. (Stockholm: P. A. Norstedt and Söner.) [187

Ministry of Public Works, Egypt: Physical Department. Climatological Normals for Egypt and the Sudan, Cyprus and Palestine. Pp. xv+148+6 plates. (Cairo: Government Press.) 40 P.T. [197

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1937. Pp. 26. (Batavia: Koninklijk Magnetisch en Meteorologisch Observatorium.) [197

Sborník vysoké Školy zemědělské v Brně. Sign. C. 34: Biometrický příspěvek k otázce vlivu individuality na délku doby březosti kilnen. Napsal Dr. Zdeněk Munk. Pp. 53. Sign. D. 25: Los evropský [*Alces alces* (L.)] v Polsku, Východních Prusích a Pobaltí (The European Moose-deer [*Alces alces* (L.)] of Poland, East Prussia and Baltic Lands). Napsal Karel Kostroň. Pp. 99. (Brno: A. Píša.) [197